DOCUMENT RESUME

ED 037 587 24 AA 000 520

AUTHOR	Gephart, William J.
TITLE	Application of the Convergence Technique to Basic Studies of the Reading Process. Final Report.
INSTITUTION	Phi Delta Kappa, Bloomington, Ind.
SPONS AGENCY	Department of Health, Education, and Welfare, Washington, D.C. National Center for Educational Research and Development.
BUREAU NO	BR-8-0737
PUB DATE	70
CONTRACT	OEC-0-8-080737-4335
NOTE	246p.
EDRS PRICE	EDRS Price MF-$1.00 HC-$12.45
DESCRIPTORS	*Basic Reading, *Educational Problems, *Models, Reading Achievement, Reading Instruction, *Reading Processes, *Reading Research
IDENTIFIERS	*Convergence Technique

ABSTRACT

This study covers a program of research on problems in the area of reading undertaken and supported by the U. S. Office of Education. Due to the effectiveness of the Convergence Technique in the planning and management of complex programs of bio-medical research, this project is undertaken to develop plans for the application of this technique in designing a research and development program on reading. The applicability of the Convergence Technique to programatic efforts in other fields of education will be examined simultaneously. This document reports only on the planning phase. The adequacy of the Convergence Technique for educational research programs will be tested in the accomplishments made through the research phase which is to follow this study. After the presentation of an overview of the proposed research and development program, this report presents a discussion of models and modeling. This material is presented to make explicit what is sought in the model building and utilization segment of the program. This is followed by material that details the nature of the program goal. Although labeled "Final Report" this document cannot be accepted as the total evaluation of the application of the Convergence Technique to reading or other educational problems. Application of the Convergence Technique to educational Research programs will be further tested in the research phase which is to follow. (ON)

BR-8-0737
PA-24

AA 000 520

FINAL REPORT
Project No. 8-0737
Grant No. OEC-0-8-080737-4335

APPLICATION OF THE CONVERGENCE TECHNIQUE TO BASIC STUDIES OF THE READING PROCESS

William J. Gephart
Phi Delta Kappa
8th and Union Streets
Bloomington, Indiana 47401

1970

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
National Center for Educational Research and Development

ED 037587

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The research reported herein was supported by the National Center for Educational Research and Development of the Office of Education, U.S. Department of Health, Education and Welfare.

ACKNOWLEDGEMENTS

Bestowing credit where credit is due is almost impossible in the project reported here. The number of people involved mounts into the hundreds. Because of the number of individuals involved and the extent of their participation, writing this report has been a difficult task. The words on the subsequent pages were put there by one writer. They were selected to capture and present the thoughts and recommendations of several groups. Positive contributions from this report must be credited to those groups. Where the report fails, two possibilities exist: either, I misunderstood the intentions of these groups; or my ability to express those intentions is not up to the task.

Special recognition must be accorded to: Louis M. Carrese and his colleagues in the Cancer Research Institute of the National Institutes of Health for the development and explication of the Convergence Technique; Howard Hjelm and Monte Penney of the U.S. Office of Education for their efforts in initiating this work and for their excellent support throughout; the members of the two planning teams, John Ertl (University of Ottawa), Nicholas Fattu (Indiana University) Monte Penney (USOE), Robert Remstad (University of Wisconsin-Milwaukee), Roger Sisson (Philadelphia, Pa.), Donald E. P. Smith (University or Michigan), Walter Stolz (University of Texas), Edward Summers (University of British Columbia), and Willavene Wolf (New York University), for their diligent effort while in session and their continued interest and reaction to materials sent them after the sessions closed; the participants of the reading definition conference, John Bormuth (University of Chicago), Sara Lundsteen (University of Texas), Monte Penney (USOE), Alton Raygor (University of Minnesota), Helen Robinson (University of Chicago), Edward Summers (University of British Columbia), and Wendell Weaver (University of Georgia), for aid in constructing a foundation on which to plan.

Appreciation is also expressed to the staff at Phi Delta Kappa Headquarters for their encouragement and support in the conduct of this project. In that group Mrs. Patti Brennan, deserves special credit for her efficiency in attending to the housing and travel needs of the individuals listed above and her willingness to type, retype, and retype the sections of this report. Recognition is also due to Miss Susan Mader, Miss Joan Hawley, and Sister Iona Taylor who worked as project assistants.

Much appreciation is also expressed to my family for their consideration and cooperation as this effort unfolded.

One additional acknowledgement should be made. This report projects work to be done in the future by persons unnamed to date. The work done by those individuals will both be affected by and will affect the quality of this work. Those involved to date wish to acknowledge the work to be done and to offer their assistance as needed.

William J. Gephart
Phi Delta Kappa

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CHAPTER I

PROBLEM STATEMENT, DESCRIPTION OF THE CONVERGENCE TECHNIQUE, AND PROJECT OUTLINE

Two developments led to the funding of Project 8-0737, "Application of the Convergence Technique to Basic Studies of the Reading Process." First, within the U. S. Office of Education decisions had been reached to undertake a program of research on problems in the area of reading. Second, the effectiveness of the Convergence Technique in the planning and management of complex programs of bio-medical research suggested possibilities for its applicability to programatic efforts in education. Thus, a project was undertaken to develop plans for a research and development program on reading and simultaneously examine the applicability of the Convergence Technique to education.

Although labeled "Final Report" this document cannot be accepted as the end or total evaluation of the application of the Convergence Technique to reading or other educational problems. The Convergence Technique involves a planning effort and a coordinated, cumulative series of managed research and development activities designed to achieve a specified goal. This project involved the planning activity only. Thus, before the Convergence Technique can be evaluated, an extensive line of interrelated investigations must be undertaken in a prescribed order; each investigation evaluated as to its contribution to movement toward the goal; and each investigation must be examined to determine whether its findings dictate a revision to the program plan. Since this document only reports the planning phase, the adequacy of the Convergence Technique for educational research programs will be tested in the accomplishments made through the research phase which is to follow.

THE NEED FOR A RESEARCH PROGRAM ON READING

Reading is a very real anomaly. No other educational speciality has received as much attention. No other educational speciality has been as frequent a subject of published reports. And, no other educational speciality has as well an organized collection of literature. Personnel of the ERIC Clearinghouse on

Reading indicate that there are between seven and eight thousand items in a comprehensive bibliography on reading, and that those articles, thanks to the work of Gray, Robinson, and others, have been summarized annually. With all of that study, it seems incongruous that a specialist in the field could say, ". . . the basic variables are unknown."[1] But it is said by individual specialists, by national organizations, and by funding agencies. The latter comes as an indirect inference from the U. S. Office of Education effort which involves 27 experiments in the teaching of reading. As analyzed by members of the office, that report failed to ascertain differences among methods for teaching reading. The first grade reading studies show that much of the variance in reading achievement is not accounted for by the instructional approaches and materials, nor by the entry skills of beginning pupils. Of the many approaches compared, no single approach demonstrated marked superiority over all others. We just do not know what is the best way to teach reading. For these reasons, the final report of these USOE studies urges future research concentration upon the entire learning situation; that is, the interaction of pupil, materials, classroom environment and teacher behavior.[2] Given our inability to account for the variance that exists in test scores of reading achievement, a logical conclusion to be drawn from the first grade reading studies would seem to be that we do not definitively know what it is we are trying to teach. What is reading? What are the behaviors involved?

Five items seem to delineate the conditions on which the work reported on these pages was conceived.

1. Improvement in reading instruction seems to have reached a plateau.[3]

2. Differing methods for teaching reading do not produce significantly different results.[4]

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[1]Margaret Hubbard Jones, "Basic Research on Individual Differences as Related to Product Development" an address delivered as part of the Symposium on Basic Versus Product-Oriented Research, November 3, 1967, at UCLA.

[2]Howard F. Hjelm and Monte Penney, "The Research Program on the Reading Process." Mimeographed paper presented at the Annual Meeting of the American Educational Research Association Meeting, February, 1969.

[3]Ibid.

[4]Guy Bond and Robert Dykstra, Coordinating Center for First Grade Reading Instruction Programs, University of Minnesota, 1967. (Final report of USOE Project 5-0341)

3. A broadly accepted model of reading, showing its constituent elements and their interactions does not exist.[5]

4. Summaries of research on reading indicate that most of the research in the field has been done in a manner that prohibits synthesis.

5. Previous attempts to concentrate emphasis on reading, undertaken on the part of funding agencies, have produced proposals for research on parts of the problem with little hope for cumulative resolution of the total problem.

Prior to this study, personnel in several federal funding agencies began to explore a concentrated attack on the problem of reading. At the same time there was pessimism about the effectiveness of programatic efforts. Given the failure in the past to generate program proposals which would lead to findings and conclusions that could be cumulated for the resolution of the problem, a decision was made to examine possible management strategies which might make the overall research program more productive.

One of the units in the National Institute of Health, the National Cancer Institute, had employed a technique which appeared promising. Known as the Convergence Technique, it is described by Carrese and Baker[6] as a method of planning and managing extensive research programs. It incorporates systems analysis techniques, extensive interdisciplinary planning of the proposed research program, and conduct of the program as an information generating and holding mechanism that is self-correcting.

In their paper Carrese and Baker argue that critical path methods cannot be applied to generalized research problems. Two basic assumptions on which critical path methodology rests cannot be made in a research program. The first of these is, all events necessary to accomplish a goal are identifiable. The second, given a sufficient magnitude of effort, all events are accomplishable. When numerous unknowns are involved these assumptions cannot be made. The technique they propose as an alternative to PERT and other critical path methods has been applied with apparent success

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[5]Jeanne Chall, Learning to Read: The Great Debate. New York: McGraw Hill, 1967, p. 93.

[6]Louis M. Carrese and Carl G. Baker, "The Convergence Technique: A Method for the Planning and Programming of Research Efforts," Management Science, Vol. 13, No. 8, April, 1967.

in the area of cancer research.[7] Given that success, the belief that a research program in reading was needed, and that it had to be managed in a scientifically acceptable and effective way, the decision was made to fund a project in which the Convergence Technique was applied to basic studies in reading.

The project that was undertaken had two objectives:

1. The generation of a logical network of research efforts on reading that could serve as a basis for requests for proposals on the part of funding agencies.

2. The assessment of the applicability of the Convergence Technique to educational problem areas.

DESCRIPTION OF THE CONVERGENCE TECHNIQUE

As indicated by Carrese's paper,[8] the Convergence Technique consists of:

(1) A planning session which initially delineates:

- (a) The goal to be achieved by the program
- (b) The subobjectives necessary for the achievement of that goal
- (c) The sequence in which those subobjectives logically move to the goal
- (d) The research needed to achieve each subobjective
- (e) The criteria which must be met in order to conclude that each subobjective has been achieved

(2) A diagram, called a Convergence Chart, which displays the five elements listed above

(3) The use of the Convergence Chart in program management for decisions on:

- (a) Specific research projects to be undertaken
- (b) Movement to the next phase

(4) Updating the possible revision of the Convergence Chart on the basis of information generated as the research program progresses

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[7]Private correspondence with scientific program directors in the Cancer Research Institute. 1969.

[8]Carrese and Baker, Op. Cit.

The project undertaken by Phi Delta Kappa, as stated earlier, concentrated on the first two of these elements, the Planning Session and the generation of the Convergence Chart.

The Convergence Technique is a systems approach derivative developed by Carrese for the express purpose of planning and managing complex research programs. Carrese came to this procedure after trying to apply critical path methods such as Program Evaluation and Review Technique (PERT) to research management. Two assumptions mediate against the utility of PERT and similar approaches when applied to research programing. First, critical path methodologies assume that all the events necessary to achieve a goal can be identified in advance. Second, all events can be accomplished if a large enough magnitude of effort is exerted. Neither assumption holds when the program being planned contains unknowns. In such a case all the necessary events cannot be predicted in advance for some of them may not be deduced from what is now known. And, even those that can be deduced may be contrary to what is fact. Fallacy or error in deduction is recognized in science. If we deduce that an event can and will take place when in reality a contrary event occurs, no amount of effort will produce the predicted event.

Given failures in research program planning with critical path methodologies, Carrese turned to the method of the scientist for guidance. In his perception the scientist structures a replication of nature, and takes and analyzes measurements of that replication. Carrese reasoned that the same approach was necessary in programatic research efforts. This proposes that a goal must be stated and that the logic of attaining that goal (the replication of nature) must be specified. Such work progresses by: stating the goal; determining the subobjectives that must be accomplished to achieve that goal; sequencing those subobjectives into as sound a replication of nature as possible with the given state of knowledge; the specification of criteria for determining the achievement of each subobjective; and finally the detailing of the research and/or development work needed to satisfy these criteria and meet each of the subobjectives.

At the outset of such a research program the number of research activities and subobjectives are large. As the work progresses, the number of unknowns should be reduced. Concomitant with this reduction, the number of alternative pathways to the goal should reduce allowing for a convergence of resources and effort on that which remains to be accomplished.

To establish a program plan (Carrese calls it a Convergence Chart) a small interdisciplinary planning team is assembled. Carrese recommends one representative of the funding agency through which the program will be implemented, a systems analyst with experience in the use of the Convergence Technique, a specialist on the problem central to the goal, and a generalist in the field in which the problem resides (with competence in the research methodology of that field). This basic team can be augmented by representatives of

the disciplines which make major contributions to understanding of the phenomena central to the goal.

It is recommended that the planning team be kept to as small a number as possible to reduce communication problems and to provide an opportunity for all relevant points to be carefully analyze and either included in the program plan, excluded or included after modification. The planning sessions are scheduled on a full time basis for four to eight weeks. During that time this planning team should be assisted in obtaining relevant information through the availability of project assistants and consultants.

The Convergence Technique recognizes that this planning team, because of its size, may not have all the available or correct information that exists related to the problem. To compensate for this the technique calls for broad solicitation of critiques of the program plan before it is implemented. Experience with the technique in National Cancer Institute programs indicates that scientists with divergent backgrounds seldom ask for major revisions in a program plan. Rather, they typically see a specific study or two as making contributions in slightly different ways than shown in the program plan. Such an observation would seem to attest to the soundness of the underlying principle in Convergence Charting, the attempt to structure the program plan in a way that replicates the overall phenomenon on which the programatic effort is focused.

Given a completed planning session and critiques of the generated program plan, a funding agency has a guide for funding which states:

1. Specific subobjectives to be achieved and a logical sequence for their attack.

2. Stated criteria for each subobjective on which to base the decision to accept that subobjective as accomplished and move to the next one in the program plan.

3. Specific projects or activities that need to be funded to achieve each subobjective.

The funding agency proceeds by contracting for the activities specified as first in the program plan. Contractors must understand that, in undertaking a project in such a programatic effort, they have two sets of criteria to impose on their work, the accepted criteria of scientific excellence which govern all research, and program relevance criteria. Their work must produce information which shows the degree to which stated criteria for that phase of the program are met.

As the first projects are completed, management aspects of the Convergence Technique come to the forefront. Program management personnel, along with advisors, need to examine the project results against the relevant subobjective criteria. If these criteria are satisfied, the next set of activities are contracted for and the program progresses. If they are not satisfied, two questions need to be explored. Does the newly generated information question the criteria and the logic of the program plan? Or does the newly generated information (including both the results and the methodology of the completed study) indicate that some additional work is necessary to meet the stated criteria and achieve the objective? Answering these questions may require the use of a panel of consultants and might lead to the assembly of another planning team.

This process of funding studies, checking their results against specified criteria, and either moving to a next stage, additional work in the current stage or replanning, is iterated until the program goal is accomplished.

PROJECT OUTLINE

The proposal for Project No. 8-0737 originally called for the assembly of a planning team for an eight week period and reporting on the deliberations of that team. Time and other constraints made it impossible to put together a team that could devote more than six weeks. At the end of that period a Convergence Chart had not been produced. At that time a decision was reached to modify the project. Under these terms reading specialists were assembled to specify a definition of reading and a second planning team was constituted to develop the research program plan. The remainder of this Chapter will present the planning and rationale that went into each of these activities, a description of them as they occurred, and an indication of their output.

The First Planning Team and Its Work

The proposal on which the USOE grant was based called for the assembly of a five member team. Carrese's writings on the technique calls for the following types: (1) a systems analysis specialist (preferably one who has participated in a Convergence Technique application before); (2) one specialist in each of the disciplines that logically contribute knowledge to the problem area; (3) a generalist-methodologist in the area encompassing the problem; and, (4) a representative of the funding agency likely to provide major support for the proposed research program. For the reading project these categories translated into the following personnel descriptions: an educator, with a systems analysis competency; a reading specialist; a psycholinguist; a neuro-

physiologist; and a representative of the U.S. Office of Education Bureau of Research.[9]

The proposal called for this planning team to work together for eight weeks, a suggestion that could not be implemented. The individuals involved were highly qualified persons; persons with busy schedules. In communication with the Bureau of Research, agreement was reached on a team that could meet for six consecutive weeks. The contacts were made formal and the group assembled in Bloomington, Indiana on August 12, 1968. Prior to that time the participant for the systems analyst role was paid to meet with Louis Carrese, the originator of the technique.

The construction of a planning team for attack on an educational problem has some difficulties not experienced in the application of the Convergence Technique in the National Cancer Institute. That organization has an operational laboratory. Organizers of a planning team there can merely step into the lab and reassign competent scientists to the planning activity. Few schools of education or other education institutions would have the range and quality of personnel necessary for a Planning Team. As a result, personnel from several places need to be contacted and involved. The reading project encountered three difficulties in this. First, because the project administration agency was not the regular employer of the participants, less control was possible. Commitments to the individual's regular employer have to be met. Second, although extensive checks of vita and references were made, it is almost impossible to know professionally an individual who lives and works hundreds of miles away. Because of this the individuals selected did not always fit the category for which they were selected.

An error was made in the selection of the team at this point. A conscious effort was made to find persons who not only represented a specific discipline, but who displayed a concurrent interest in reading. As a result the team had more than one "expert" on reading. Each of these persons had a different view of what reading is. The remaining members heard divergent statements about the nature of reading. In the absence of hard data to support one viewpoint or another, these remaining planning team members tried to become knowledgeable about reading, an activity that took time from the planning of a Convergence Chart.

The third difficulty in selecting participants from afar is the lack of back-up personnel. Midweek prior to the

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[9]The names and vita of persons in this planning team, the reading definition conference, and the second planning team are presented in Appendix D.

planning session word was received that the medical researcher had to withdraw due to health reasons. It was impossible to secure the same set of competencies on a three or four day notice.

Some of these difficulties could be overcome by holding a preliminary conference involving more persons than are necessary for a planning team. The observation of persons and interactions in that presession could give helpful information not typically available now.[10]

The planning team met daily from 9 to 4, five days a week. It is rare that professionals work together as closely and for as long a concentrated period. A good portion of that time at the start is required for learning each other's language. The shades of meaning of a common term possessed by different individuals deter cooperative effort. The typical professional interactions in education fail to expose meaning differences and consequently abet the "talking past each other" described by Gage.[11]

The planning team's work was recorded in two ways, notes taken by project staff members and by polaroid pictures of statements, drawings, and symbols developed by the group on a chalkboard in the meetingroom. This latter technique provided a recording of the group's thinking which apparently made two contributions. First, the chalkboard-photograph technique seemed to concentrate the thinking of the group in a way not observed in groups using secretarial or electronic recording. A point written on a chalkboard is more permanently in front of the group than is a point which is stated orally. The individuals in the group knew that the photographic record was being kept and seemed to want to work to some level of resolution of any such point before the picture was snapped. This, too, contributed to more careful consideration of points made than is typical in oral discussions.

In an oral discussion a point is proposed and verbally elaborated by a speaker in a way which stimulates another participant to bring up a related but slightly different point. This second speaker's comments can and often do touch off a chain of responses from still other members of the group. It is not uncommon in group discussions for such conversations to move completely away from the initial point and never return to

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[10]Chapter 11 of this report examines problems in the application of the Convergence Technique encountered in this project and recommends procedures for overcoming or avoiding them in future applications.

[11]N. L. Gage & W. R. Unruh, "Theoretical Formulation for Research on Teaching." Review of Educational Research 37:358-370; June 1967. p. 366

it. When this occurs several things are possible. The original point may be forgotten completely by the group. One or more members of the group may assume that the point was accepted while others think the opposite. And, one or more members of the group may think that any difficulties in the completeness or logic of the original point have been resolved while others do not. Any of these cases cause problems in the joint effort and product. When a point is placed before a group in a static visible form (on the chalkboard), the likelihood of these possibilities is reduced.

The second advantage of the polaroid recording of chalkboard notes is immediacy of recall. When it becomes necessary to return to a point worked on earlier, it is an easy task to find the appropriate photo.

The planning team was told at the start of their work that the project staff would assist them in their deliberations by obtaining copies of documents referred to, and by identifying and arranging for consultants as the team members identified the need for information beyond that possessed by the group.

The first task of the team was the delineation of the major objective. Carrese has indicated that this deliberation can last several weeks. It did. In the interim goals were proposed, analyzed this way and that, cast aside, and in some cases resurrected. At the close of the fifth day of meetings an objective had been placed on the board that seemed to have general acceptance. It was, "To specify the conditions under which 95 per cent of ten year old children will achieve a criterion level of literate behavior." On the ninth day the discussion centered on a different objective, "To build a theory and model of reading." The statement of the objective in the final week of the team's deliberations was, "Proven ability to affect a criterion level of literate behavior on the part of 95 per cent of ten year olds." The block diagram of the research program for this objective displayed a subobjective, the development of a computer simulation of reading or an explanatory and predictive conceptual model. Thus, both objectives were retained as the planning proceeded.

The decision to include a model building activity in the research program led the team to a search of various disciplines from which contributions of knowledge might be expected. As the list of disciplines grew, the question of inclusion and exclusion criteria was faced. On what basis is any discipline to be added to or omitted from the list? The answer seemed to lie in the statement of a definition of the term, "reading." The selection of a definition of reading was not accomplished during the first planning session. It was recognized that reading can be

defined differently by persons with different vantage points, a fact recognized and documented by Clymer.[12]

An analysis of numerous definitions using the Guttman Facet Design and Analysis Technique[13] was undertaken. The elements identified were the subject of discussion and literature search for the major part of the last ten days of the planning session. At the close of that session the information for a definition of reading had been identified. The project director accepted the responsibility for synthesizing these materials into a definition of reading.

A procedure for that definitional effort was provided by the work of Cady on the term, "music education."[14] Cady's paper implies that definition of a complex entity cannot be accomplished in a single sentence or brief paragraph. He proposes instead, a two-fold attack. The first element is an analysis of the way in which the term is used. The second element includes six definitional approaches. Using these categories and the approach a definition was developed (See Appendix B.)

As the original contract period drew to a close, a summary fo the work accomplished and the financial status of the project were discussed with representatives of the Office Of Education. Those discussions recognized that a Convergence Chart had not been developed. A tentative goal statement and a tentative definition of reading, however, were in hand. These two items were judged necessary to further planning efforts. Initial critical reactions to the definition statement indicated that it warranted further work. That definition, although outlined by the first planning team was written by the project director, an individual lacking credentials in reading. It was reasoned that if the definition was broadly acceptable to professionals in the field of reading, a second planning team should be able to produce a Convergence Chart.

Through these discussions a decision was reached to extend the contract for pursuit of the following three activities.

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[12]Theodore Clymer, "What is 'Reading'?: Some Current Concepts." Innovation and Change in Reading Instruction, NSSE Yearbook, Part II, Chicago: University of Chicago Press, 1968.

[13]As described by Philip Runkle, "Some Recent Developments in Research Methodology." Eugene, Oregon, 1965. (ERIC Document Number ED 010 221.)

[14]Henry Cady, "Toward a Definition of Music Education." Conference on Research in Music Education, Columbus, Ohio, March 1967, Cooperative Educational Research Project Number 6-1388. (ERIC Document Number ED 013 973.)

1. The solicitation of critiques of the definition of reading from recognized experts in the field of reading.
2. The synthesis of these critiques by a small group of persons knowledgable about reading.
3. The conduct of a second planning team session for the development of a Convergence Chart.

The Reading Definition Conference and Its Work

Copies of the definition statement were sent to 150 persons in the field of reading. These individuals were identified by the project director through communications with the International Reading Association (IRA) and the U.S. Office of Education. Lists provided by those agencies were augmented by a search of the ERIC holdings for authors of documents which demonstrated some concern for defining the term "reading." Fifty of these persons were offered an honorarium for critiquing the definition statement. The nature of the requested critique was structured to solicit positive and negative comments and comments based on empirical evidence or personal insights. The remaining 100 recipients were invited to submit critiques without the offer of an honorarium.

This mailed request generated thirty-one responses, twenty-one of which were critiques. Those critiques and the original definition paper served as inputs for a reading definition conference. Participants in this conference included six persons with experience in reading research (one of whom had served on the initial planning team), the U.S. Office of Education representative who served on the initial planning team, and the project director.

After studying the tentative definition and verbatim copies of the solicited critiques, the reading definition conference participants made two recommendations. First, after some revision the tentative definition of reading should be made available as a part of the report on this project (See Appendix B). Second, a definition of the term "reading behaviors" should be substituted for the definition of "reading" as the basis for research planning in this application of the Convergence Technique.

The paper defining "reading" uses an analysis of the usage of the term and six definitional approaches. Although the definition conference participants indicated that this multiple definition approach aided their thinking about the task facing them, they recognized in it the criticism stated by Clymer. "Much that we need to know (to define reading) must await further developments in basic and applied research."[15] In

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[15] Op. Cit. p. 28.

lieu of the unknown, the tentative definition of reading uses other constructs about which there is still much that is unknown. Kerlinger calls such definitions "constitutive definitions," that is, "...a definition that defines a construct with other constructs."[16] In the opinion of the definition conference participants, a research program should be based upon an "operational definition," that is, "...a definition that assigns meaning to a construct or variable by specifying the activities or 'operations' necessary to measure the construct or variable."[17]

READING BEHAVIORS: AN OPERATIONAL DEFINITION

After some discussion the participants agreed on the following definition.

READING BEHAVIORS are covert responses (1) to verbal (2) written language (3). These covert responses are indicated (4) by overt performance (5) which could not have occurred without (6) the covert responses to the written language.

In their discussion eight key elements of that definition were elaborated. Those elements have been set off in the definition by underlining and numbering. Those elements are defined below.

(1) Covert responses. Acts or actions to a motive force that is hidden from observation. Physiological and psychological processing that is unobservable given current methodology is included as are the mental events and patterns of events that presumably mediate overt behaviors.

(2) Plurality of covert responses. In an effort to be explicit, emphasis is given to the idea that a variety of responses occur. This plurality is further emphasized through the pluralization of the term "reading behaviors."

(3) Language. The words and the methods of combining them used and understood by a considerable community and established by long usage.

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[16]Fred N. Kerlinger, Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, Inc., 1964 p. 34.

[17]Ibid. p. 34.

(4) Verbal language. This adjective is included to emphasize that the language in question is one of words. This adjective excludes artistic, musical, and number languages from the definition.

(5) Written verbal language. Verbal language can be produced in either of two forms, visual or oral. The inclusion of the adjective "written" is intended to include language that is recorded in visual form and to exclude language that is oral.

(6) Overt performance. This term includes actions or activities that are observable with or without instrumentation.

(7) Indicated. A logical connection between the overt performance and the covert response is impled through the verb "indicated." The definition implies through this term that the observation of the overt performance shall be taken as evidence of the existence of covert responses.

(8) Could not have happened without. This bit of redundancy is included and emphasized to highlight the need for scientifically sound empirical evaluation which establishes that the overt performance is related to and/or caused by reading and not by other factors.

This definition merges the constitutive and operational. Its first sentence is the explanation of one construct, "reading behaviors," by a second, "covert responses." The second sentence, which is intended as a part of the definition, inserts overt performances, operations which can be observed and/or measured, and asserts that their observation shall be taken as indicators of the responses and thus of reading behaviors.

This mixture of definitions was affected knowingly by the reading definition conference participants. They were simultaneously striving for a definition that had denotative strength as the basis for research and scientific utility for theory development. The importance of operationalism for research has been cited in many writings on the research process. Scriven says, "...there is only one standard for good definitions, and that is inter-user reliability in their use in a given verbal or empirical context..."[18] The best way to ensure high inter-user

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[18]Michael Scriven, "The Philosophy of Science in Educational Research." Review of Educational Research 30:422-9; Dec. 1960.

reliability is the use of directly observable and mechanically quantifiable elements in definition. A length of "one foot" fits these requirements. It can be directly observed and is easily quantified. One of the goals of reading research as posed by the reading definition conference participants is akin to developing standards like "one foot" for the field of reading. That is, reading research must: (1) identify those directly observable items, actions, or events that are correlates of the covert responses; (2) determine with scientific conclusiveness the dependence of the overt performance on the covert responses; and (3) develop valid scales for quantifying those overt performances.

The Second Planning Team and Its Work

After the definition conference was completed the decision to constitute a second planning team was reviewed and affirmed by the project director and U.S. Office of Education personnel. Again lists of possible participants were generated and contacts with identified persons were begun to explore their interest in the activity. Based upon the apparent mistake made earlier which led to having several "reading experts" on the team, an effort was made this time to secure only one specialist per substantive area for the team.[19] Again, specialists were sought in the area of reading, educational research, systems analysis, psycholinguistics, and neurophysiology. The reading specialist selected was the same individual selected for that role in the first planning team and who participated in the reading definition conference. The educational research specialist selected had also participated in the first planning team. A systems analyst was selected whose training, experience, and normal employment is outside of the field of education. Prior to the commitment of the systems analysis role to this individual, he was asked to meet with Carrese, examine the technique, and report back his reactions to the project director. A psycholinguist was identified whose training and subsequent research did not include studies of the reading process.[20] Although many contacts were

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[19]The formation of the first planning team was guided by the belief that each member would represent a science which contributes to the study of reading and personally possess as much knowledge about reading as possible. This belief on the part of the project director and the USOE Project Officer proved to be a mistake in that the first planning team contained so many persons knowledgeable about reading that the ensuing discussions bogged down in details; movement towards a gross program plan was therefore slow. These comments, and others relating to the choice of personnel, reflect upon the appropriateness of the choices and not upon the general competence of the persons selected--all of whom made distinct contributions to the planning project.

[20]This proved to be a difficult task as many psycholinquists have done research on reading. Those who have not expressed a lack of desire to expend as much time concentrating on reading as is required in this project.

made with researchers in the field of neurophysiology, it was impossible to find an individual who could commit sufficient time to serve as a planning team member. The final position in the second planning team went to the Office of Education representative who had participated in the two earlier groups.

The second planning team met three days a week for a five week period starting September 15, 1969. Prior to their first session each of the participants was sent copies of the Carrese-Baker paper on the Convergence Technique, an interim report on the project, and a copy of the paper summarizing the work on definition (appendix B). Recording procedures described in connection with the first planning team were repeated with the second group.

After a brief statement about the project and its history by the project director, the systems analyst was asked to give a description of the technique and to set procedural rules for the group. Like the earlier group, the second planning team moved quickly to a discussion of a program objective. The objective statement made by the first planning team and program goal suggestions discussed in the reading definition conference were considered by the second planning team. Within the first day of their deliberations this group set the following statement as the program goal.

> 100 per cent of all people (not in permanent care institutions) over age 10 can complete 90 per cent of the tasks involved in functional reading competence.

The second planning team explicitly sought a program goal which reflected the benefits of reading to a person in this society rather than a research-oriented goal. This is consistent with the Convergence Technique and with the notion of a federally-funded national effort. As the team continued its efforts this objective was detailed further but with little major modification. That detailing is presented as Chapter 4 in this report.

After reaching initial agreement on the overall goal this planning team was led by questions posed by the systems analyst to a consideration of the work necessary for its accomplishment. Four streams of activity were initially stated as alternative paths to the goal.

1. A theoretical approach involving basic science first to detail the nature of reading and reading behaviors, and secondly, engineering (based on the scientific findings) to develop the vehicles needed to create these behaviors.

2. An empirical approach involving the identification of key elements in reading and procedures effective in developing them, by means of sequential experimentation.

3. A formal approach in which a complete experimental design and massive study would determine the nature of the crucial factors and their interactions necessary for achieving functional reading competence.

4. A clinical approach involving the specification of failures of existing reading instruction and the clinical selection and development of means of resolving these failures.

In parallel with these streams was another line of investigations which had as its purpose the specification of the goal, functional reading competence, and delineating the target population through the generation of descriptive data and inclusion-exclusion criteria.

As the team continued the discussion of the four streams, number three was dropped. It was reasoned that the current state of knowledge was such that crucial variables would probably be omitted. Further, the number of variables known to be involved in reading, and thus, the size of this "grand experiment" would be so great as to make it impossible to conduct.

Discussion of the remaining investigative lines was directed in part by the question, "Given what is known to date about processes of (1) reading, (2) learning to read, (3) language development related to reading, and (4) reading instruction, what are the most likely alternative routes to the achievement of the program goal?" Two were identified which provide the basis for the program plan. Together they comprise the major focus of Phase II.

The first of these routes (and there is not priority intended in this listing) starts with a recognition that (1) the body of literature possessed by the field of reading contains numerous models of the processes of reading, learning to read, and language development (Some of these are explicitly labeled as models while others are not.); (2) the existing models seem to be in a very rudimentary state (i.e., most of the models are incomplete and lacking in direct empirical documentation); and (3) reading instruction developments do not seem to have been based on a careful extrapolation from models. This route to the goal calls for the identification of existing models of the processes of reading, learning to read, and language development related to reading; the further development and refinement of these models; and, their use in the design and engineering of reading instruction. Again, more detail regarding this aspect of the proposed TRDPR program is presented in Chapters 3, 8, and 10 of this report.

The second route starts with the recognition that (1) existing reading instructional programs are successful in achieving functional reading competence with some of the target population; (2) comparative studies have not shown one approach to be more effective than another; and (3) reading instructional

programs have seldom been systematically examined and adapted to correct for their failures. This second route to the goal calls for carefully controlled, adaptive and iterative experimentation in a number of ongoing reading instruction programs, each of which takes a different approach to instruction.

The successful products of either of these routes is seen by the planning team as prototype components for a reading instruction system. Before they are accepted as components to be incorporated in a system though, they must be subjected to confirmation tests. Each component (whether it was produced through work with models or through adaptive experimentation) will have been made to work by its developer(s) in a specific setting. The confirmation proposed seeks answers to the questions: will it work in other settings? and will it work without the aid and/or presence of the developers?

Given the identification of these alternative routes (and the inability to predict that one is likely to be more successful than the other) the planning team turned its attention to two questions. First, what needs to be done prior to the start of work on these two routes? And second, given the successful completion of confirmation tests on components for increasing functional reading competence, what needs to be accomplished to achieve the program goal?

The first of these questions led to the specification of a literature search and synthesis designed to identify all existing models, consolidate or merge where logically possible, and, after an evaluation of what is known about each model, to propose the research efforts deemed necessary to empirically confirm or refute their validity and develop those valid models to a level at which they are useful in engineering instructional approaches and materials. Simultaneously, the planning team called for a search and synthesis of the literature which describes reading instruction and its products.

The activities which follow Phase II assume that a quantity of instructional system components have been developed and their effectiveness has been confirmed. Phase III calls for the design and testing of an overall instructional system. Once that has been completed the work (Phase IV) will focus on the development of the supportive and auxillary items that are necessary to ensure proper implementation and utilization of an effective instructional system. Finally, an analysis must be made of the effectiveness of strategies for affecting the adoption of the new instructional system by educational agencies throughout the country. The planning team's identification of these activities created in effect a five phased program as outlined below.

Phase I - Preresearch Activities (Literature searches and goal refinement work)

Phase II - Instructional System Component Research, Development and independent confirmation activities

Phase III - Instructional System Assembly and Test

Phase IV - Delivery System Development and Test

Phase V - Implementation Strategy Assessment

(An activity through which an instrument (or instruments) for assessing the achievement of the program goal was also specified as a part of the R&D plan to run parallel with all phases. These efforts would concentrate most heavily during Phase I and the beginning of Phase II. After that time this line would involve periodic sampling of the population to ascertain the degree to which a problem exists. See Figure 1)

The program plan outlined above was achieved almost in that form by the end of the second week of the planning team's work. At that point the team turned its attention to three aspects of planning prescribed in the Carrese-Baker description of the Convergence Technique: (1) The specification of subobjectives necessary in accomplishing the program goal; (2) the statement of criteria for determining the success or failure in accomplishing each subobjective; and (3) detailing, where possible, the specific activities and projects necessary to achieve each subobjective. The team prepared brief descriptions of the products of each phase and in some cases products to be developed within a phase. It also produced criteria statements for each of these products and in some cases detailed descriptions of activities. It will be recognized as the reader progresses through this report that detailing of activities concentrates on the early phases. Until the work is accomplished, it is difficult to be very specific about activities in latter phases.

As the planning team developed statements of criteria for each of the subobjectives, a benefit of the Convergence Technique was observed. By this time a rough outline of the proposed program plan had been sketched on a long sheet of butcher paper fastened to the wall. As criterion statements were developed they were fastened to it at the appropriate program decision point. Not infrequently agreement on a subobjective criterion statement led to the recognition that the activity already on the developing chart had to be modified, and in some cases, that such modifications required changes in other parts of the proposed plan. This process evolved the program format outlined above and detailed in subsequent chapters of this report.

During the next to the last week of its work the planning team discussed the need for and the role of a program information system. The existence of this information system is indicated in Figure 1. Its nature will be detailed in Chapter 7 of this report. Every Convergence Technique application to date has included an

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING

PHASE PRODUCT BLOCK DIAGRAM

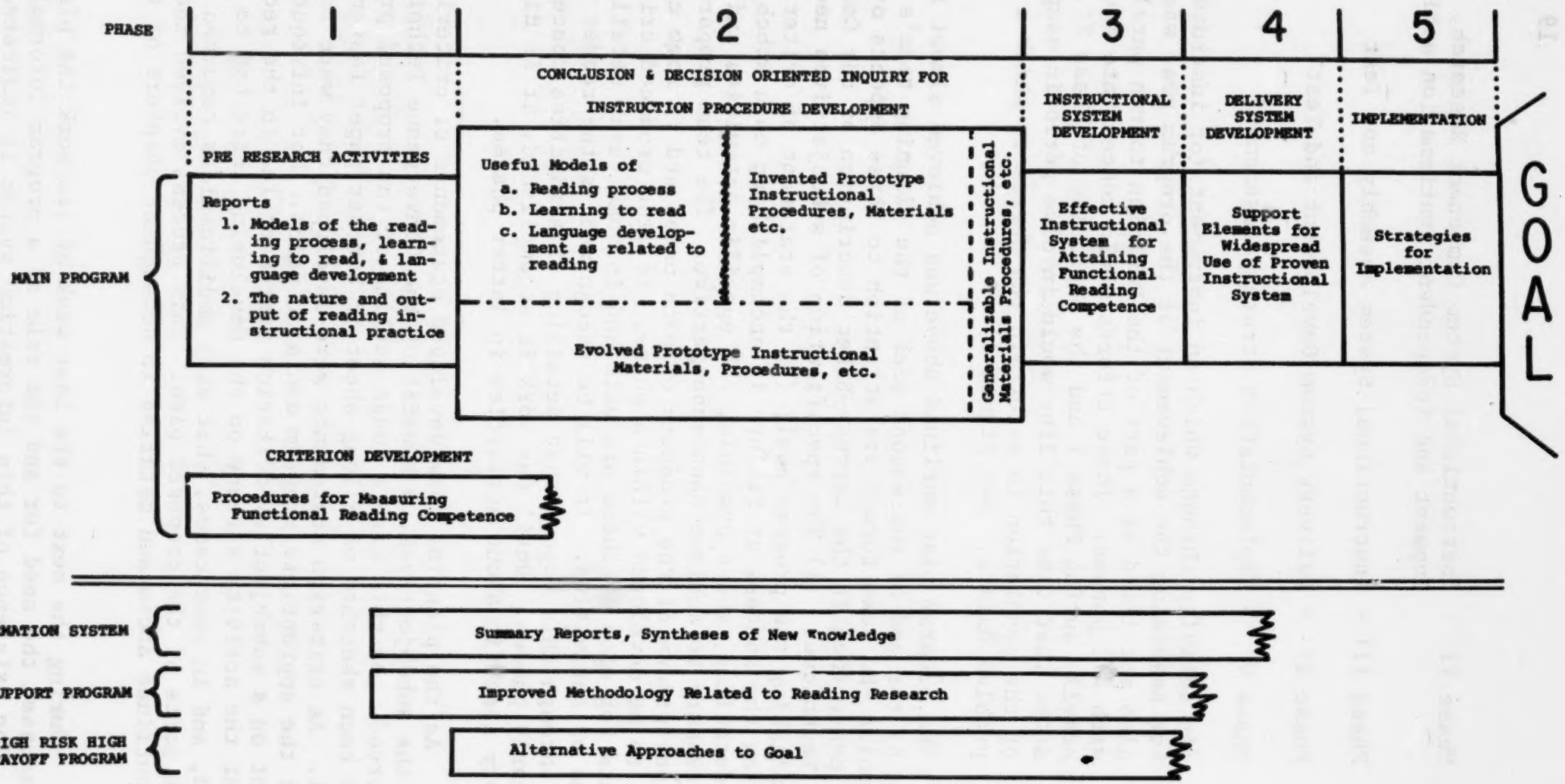


Figure 1.

information system capable of storage and retrieval of all aspects of completed work and capable of disseminating new findings to all program elements with little lag time. The benefits of this information system can readily be seen in the communication it would facilitate between the theoretical research (model-building) and adaptive experimentation paths described above. A research finding that makes clearer the nature of the reading or learning to read process could be extremely helpful to personnel in an Adaptive Experimental Laboratory (AEL). Conversely, the discovery of an effective intructional procedure (or for that matter, an ineffective procedure) could be helpful to researchers on models.

In its final week the planning team did four things: (1) tested the logic of the plan by taking a hypothetical activity and working both forward and backward through the program; (2) estimated time, personnel, and costs for the identified activities; (3) discussed the advancement, management, and funding of the proposed program; and (4) assisted the project director in the preparation of an interim report to the Office of Education which contained the following recommendations. (See Appendix E for the complete statement.)

1. The program plan proposed in the report of the project (and summarized herein) should be implemented as soon as organizational and budgetary arrangements can be made within the Office of Education.

2. Three projects proposed in the plan are so vital to the attainment of functional reading competence (either through the proposed program or any other effort with the same general goal) that they should be initiated immediately through the USOE National Center for Educational Research and Development.

3. The Convergence Technique should be used in future programatic efforts of the Office of Education.

The team has continued to contribute to the development of the TRDPR plans after their departure from Bloomington by reviewing and critiquing written statements about the work they started. Such cooperation is vital to the preparation of a report based upon intensive group efforts.

STRUCTURE OF THE REMAINDER OF THIS REPORT

After the presentation of an overview of the proposed research and development program, this report presents a discussion of models and modeling. This material is presented to make explicit what is sought in the model building and utilization segment of the program. This is followed by material that details the nature of the program goal.

Following these two rationale sections, the report turns to a detailing of the work in Phases I and II. Each of these sections will present a description of the product(s) sought through the work of the program, a rationale for that effort, the criteria that have been specified on which to base a decision that these products have been accomplished, and a description of the activities the planning team was able to describe as necessary to the completion of each of these products. The report will also present a discussion of the management considerations that must be attended to to further the work in Phases I and II and recommendations for the use of the Convergence Technique in other educational problem areas.

The reader will note Phases III, IV and V are not elaborated in the body of this report. Their general direction and criteria will be stated in the overview section. They are not the subject of further detail because their exact nature is dependent on the output of Phases I and II. The planning team discussed each of these phases at length. Part of this discussion was devoted to examining what activities would be required <u>if</u> the previous phase product had a given set of characteristics. It was possible, in this exercise, to state some general areas of work and the phase criteria. As one phase draws to a close, a planning team will be convened to reexamine the entire program logic and further detail the phase activities.

The final portion of this report consists of appendices which include: a chronology of events leading to and associated with the conduct of this project; the reading definition paper; a glossary of terms used in this work; examples of work in Phases III through V; vitae of the personnel involved in the project; and the interim report submitted to the Office of Education.

CHAPTER II

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM ON READING: AN OVERVIEW

The field of reading has two assets on which the proposed Targeted Research and Development Program on Reading (TRDPR) is based. First, the literature on the field presents models of the reading process, the process of learning to read, and of reading instruction. Some of these models have been subjected to empirical tests and have been at least partially confirmed. Second, large numbers of children learn to read as they move through schools. The TRDPR assumes that, by becoming more systematic in model building and in instructional system development, functional reading competence can be attained by all. The combination of the program plan presented on these pages and continued application of the Convergence Technique management procedures should make the needed work on model building and instructional system development more systematic, efficient and cumulative than it has been in the past.

The TRDPR plan involves (See Figure 2):

1. the identification of existing models of the reading, learning to read, and reading instruction processes through systematic literature search and syntheses;
2. further refinement, development and empirical confirmation of existing models of the reading and learning to read processes to the point at which they facilitate accurate explanation and prediction of reading behaviors and thus become useful bases for engineering instructional materials and procedures (Confirmation also implies the refutation of those models that cannot be empirically documented);
3. concurrent with (1) and (2) above the plan calls for systematic adaptation of instructional programs by experimentation designed to reduce the discrepancy between reading instruction objectives and outcomes;
4. the conduct of independent confirmations to assess the communicability, effectiveness, and robustness of prototype materials, procedures, or equipment developed in either (2) or (3) above;

THE TARGETED RESEARCH & DEVELOPMENT

PROGRAM FOR READING - TRDPR

PHASE ACTIVITY BLOCK DIAGRAM

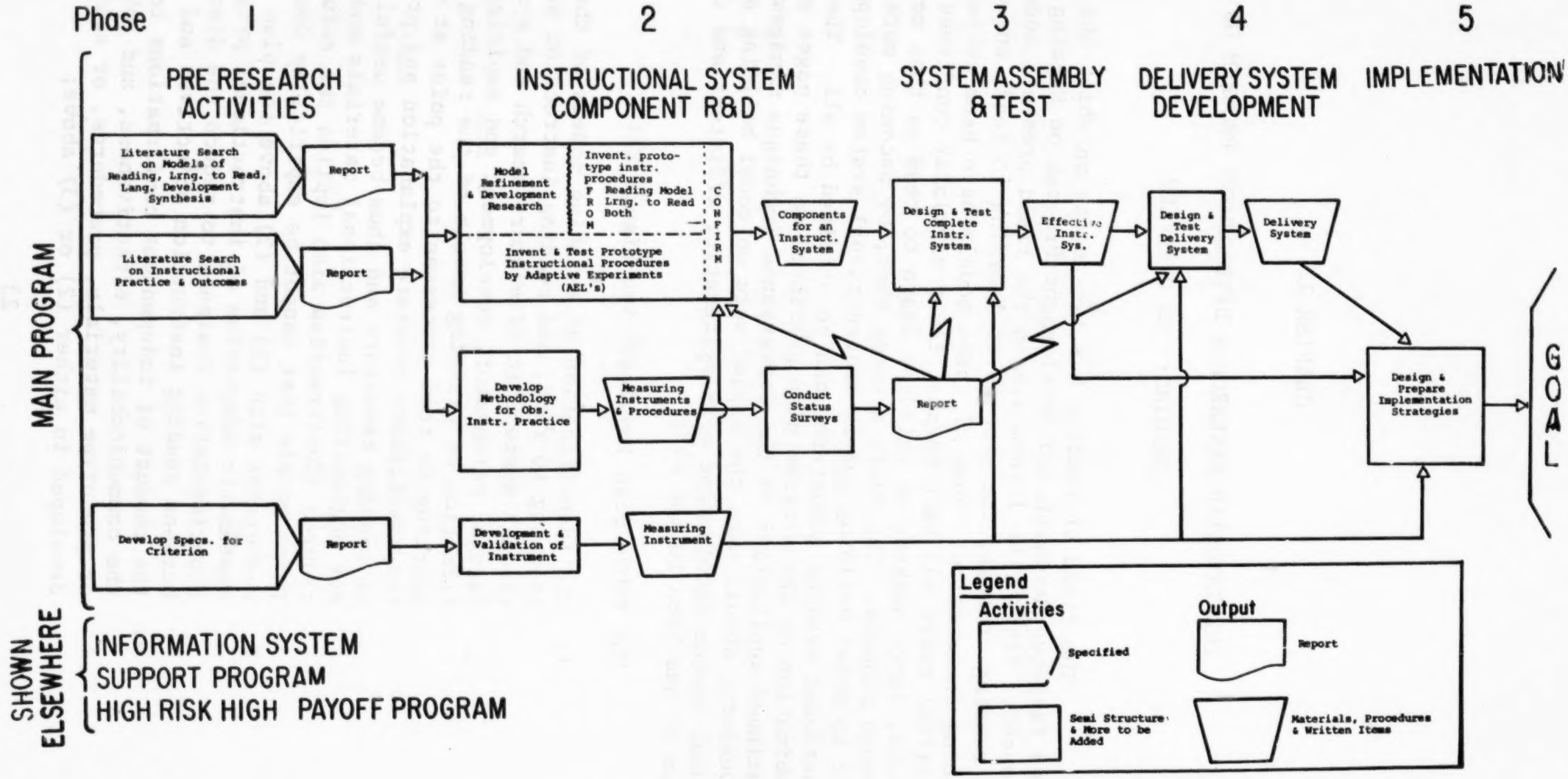


Figure 2

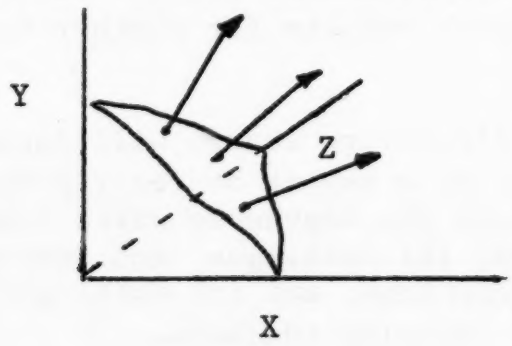
5. the design and testing of an instructional system which incorporates the items proven effective in (4) above into an instructional system capable of achieving the program objective, functional reading competence;
6. the design and testing of a delivery system, i.e.; the supportive materials, procedures, etc., necessary to ensure effective use of a proven instructional system; and
7. design of strategies for stimulating implementation of instructional systems which have been proved effective.

This chapter presents a general description of each of the five phases in the TRDPR plan along with general discussion of the procedures to be followed in its implementation. The purpose of this chapter is to give the reader a general idea and rationale of the overall program. Detailed statements regarding Phases I and II will be presented later and Phases III, IV, and V are discussed in appendices.

Functional Reading Competence: The Program Goal

Successful performance in reading tasks deemed an intregal part of adult life is the ultimate objective of this program. The program calls for the delineation of those tasks and their predication through performances of ten year olds. Obviously that functional reading competence is multi-dimensional. If it were only three dimensional, it could be displayed as the surface in Figure 3.

FUNCTIONAL READING COMPETENCE: THE TRDPR GOAL



The TRDPR Program goal is to get all 10 year olds (except those in permanent care institutions) beyond the surface labeled XYZ.

The TRDPR criterion instrument will consist of reading tasks that define the surface XYZ.

Figure 3.

Phase I of the Program: Goal Specification and Knowledge Synthesis

As indicated above the program goal is the attainment of a level of functional reading competence on the part of ten year

olds, a level that leads to effective performance of adult reading tasks. The first task of the Targeted R&D Program on Reading is to define the quantitative aspects of the goal statement. This requires the identification of adult reading tasks required for this culture. Some work has been attempted to set the minimum reading competence for survival and much has been said about the other extreme, the "perfect reader." The program goal has a standard somewhere between these extremes, a standard that must be set after weighing the economic, political, personal, and social factors related to and/or affected by reading competence. Setting that standard involves value judgements, an activity that must be broadly based. Once the standard of functional reading competence has been set, instruments for assessing its attainment must be developed. This latter activity is seen as a part of Phase II.

The activities related to goal and standard specification in Phase I along with a description of anticipated products are displayed in the bottom row of boxes in Figure 4.

Concurrent with these program standard specification activities, the program plan calls for literature search and synthesis efforts in two general areas. The first of these concentrates on the nature of three phenomena: the reading process, the learning to read process, and language development related to reading. The goal of the literature search on these three phenomena is a delineation of the models, the representations of these phenomena, that have been developed. This effort is included in the program on the assumptions that: carefully developed and adequately tested models of phenomena facilitate the understanding of those phenomena; and that understanding of the target phenomenon is a requisite in improving its instruction. This literature search, as shown in the criteria statement for Product #1 in Figure 4, will specify the research efforts for further model development in Phase II.

The second literature search will focus on instructional practice. Its product is a report or reports which: (a) synthesize what is known about the degree to which functional reading competence is achieved; (b) catalogue and describe current reading instruction practices; and (c) catalogue and describe current practices for training teachers.

The program plan calls for these two general literature search activities to be completed by June 30, 1971. Literature synthesis is not terminated at that point, however, as the program plan calls for its continuation through an information system throughout the programatic effort.

Phase II of the Program: Development of Instructional System Components

Two major activities structure Phase II of the program, the development of instrumentation for assessing the attainment of

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR

PHASE I

Conduct project(s) which
A. Identifies literature that discusses the reading process.
B. Catalogues the following
   1. Models of the process
   2. Assumptions underlying both these models and the research or logic which substantiates them.
C. Evaluates the methodological adequacy of the empirically based facts.
D. Synthesizes the methodologically sound empirically based facts with the identified models.
E. Synthesizes identified models where logical or empirical basis for combination exists.
F. Identifies empirical studies that need to be conducted to
   1. Support or reject the combination of two or more models.
   2. Test specific hypothetical elements of identified model(s)
   3. Define concepts contained in a model(s)
   4. Develop the "calculus of operation" of the model(s)
   5. Establish the predictive capability of the model(s)

Conduct project(s) which accomplish A through F on the learning to read process.

Conduct project(s) which accomplish A through F on Language development as related to reading.

PRODUCTS

#1 A report which:
   a. Identifies existing models of the
      1) reading process
      2) process of learning to read
      3) language development related reading
   b. Synthesizes common items in a.
   c. Identifies & evaluates assumptions, facts & hypotheses in the literature
   d. Relates items in c. to output of b.

CRITERIA

Product #1 Synthesis of knowledge on reading
An independent review panel agrees that the report presents or encompasses:
a. All reasonable and known models,
b. The most parsimonious synthesis of the identified models,
c. All of the assumptions, facts & hypotheses known and related to the models,
d. Facts and hypotheses known about the basic phenomena but not related to any of the models,
and, that the report identifies empirical studies that need to be conducted to:
a. Support or reject the combination of two more models,
b. Test specific hypothetical elements of an identified model(s)
c. Define concepts contained in a model(s)
d. Develop the calculus-of-operation of the model(s)
e. Establish the predictive capability of the model(s)
(Target date--June 30, 1971)

CRITERIA MET? YES → START PHASE II MODEL REFINEMENT & DEVELOPMENT RESEARCH
NO → TRANSMIT ALL MATERIALS & SUGGESTIONS FOR ADDITION AND REVISION TO INFORMATION SYSTEM

Conduct project(s) which
A. Identifies literature and existing survey data on the nature and amount of current instructional practice for the development of functional reading competence.
B. Catalogues
   1. Teacher behaviors
   2. Materials and equipment employed
   3. General approaches and procedures used
   4. Time and resources expended directly in instruction and indirectly in supervision
   5. Level of functional reading competence attained categorized by
      a. Characteristics of learner (Sex, age, race, physiological factors, I.Q.)
      b. Characteristics of learner's environment (socioeconomic level, geographic areas, language spoken in home)
   6. Teacher training amount and nature.

#2 A report which identifies, evaluates & synthesizes available data on:
   a. The nature of FUNCTIONAL READING COMPETENCE attainment in U.S. population
   b. Current instructional practices for attaining a.
   c. Current teacher training for b.

Product #2 Report on Instructional Practice
An independent panel agrees that the report identifies:
a. Current degree to which functional reading competence is achieved
b. The nature and use frequency of instructional approaches, procedures, materials and equipment used to achieve functional reading competence
c. The nature and extent of teacher education in preparation for b.
(Target date--June 30, 1971)

CRITERIA MET? YES → START PHASE II ADAPTIVE EXPERIMENTATION
NO → TRANSMIT ALL MATERIALS & SUGGESTIONS FOR ADDITION AND REVISION TO INFORMATION SYSTEM

Conduct project(s) to develop thesaurus-dictionary.

#3 A thesaurus-dictionary of reading terms

Product #3 A Thesaurus-Dictionary
a. A thesaurus is available listing the terms basic to the reports in PHASE I Products #1 & #2
b. Each term in the thesaurus is placed in a hierarchical structure by presenting with it
   1. the terms under which it is subsumed (Broader Terms)
   2. the terms which it subsumes (Narrower Terms)
   3. other related terms
c. Standardizes vocabulary by specifying the term used in cases of synonyms
d. A dictionary coordinated with the major terms in the thesaurus
and, a panel of specialists certifies that the thesaurus includes all of the relevant terms, that the hierarchical structures are correct, and that the definitions are consistant with what is known about the phenomena involved.

CRITERIA MET? YES → TO INFORMATION SYSTEM
NO → RECYCLE TIL COMPLETE

Conduct project(s) which
A. Define and describe the population on which the R & D for R program focuses giving both inclusion and exclusion parameters.
B. Define and describe major subsets that comprise that population
C. Identify reading tasks encountered in U.S. culture
D. Categorize reading tasks into those
   1. Everyone should be able to perform
   2. Which are optional
E. Identify reading tasks appropriate for age 10 that are logical predictors of the reading tasks in VII. D. 1.
F. State the performance level (and concomitant the error level) to be included as the standard for performance on the reading tasks identified in VII. E.
G. Determine the level of expenditure for instructional program operating which will be a second criterion in the R & D for R program goal.

#4 Specifications of:
   a. Target population and its subsets
   b. Functional reading competence criterion for the R & D for R Program
   c. Financial criterion for the output of the R & D for R Program

Product #4 Specification for the Development of a Criterion Instrument
A program objective statement which specifies:
a. The characteristics of the population on which the R & D for R program is focused,
b. The reading tasks which comprise the program standard,
c. The resource levels within which output of the program must operate,
has been stated, reviewed and approved by
a. An advocacy panel of specialists in reading, economics, sociology, psychology and education,
b. Program management personnel,
c. Program policy makers in the USOE and Department of Health, Education & Welfare.

CRITERIA MET? YES → START PHASE II INSTRUMENT DEVELOPMENT
NO → RECYCLE TIL COMPLETE

Figure 4

functional reading competence and the development of effective prototype components for a reading instruction system. Once valid instrumentation exists surveys will be conducted to determine the degree to which the standard is met at that point in time. The results of those surveys will provide both base line data and further detail regarding the nature of the problem. It is possible that these surveys will show that the agreed upon standard is being met, i.e.; that the level of functional reading competence this society deems necessary and is willing to pay for is being achieved. If that is the case, the program will be terminated as the program goal has been met. Although it is perhaps pedantic to make such statements, they are presented here because the existence of "a reading problem" has not been empirically documented. Rather, its existence has been asserted by persons who employ the products of our schools, who further educate those products, who are in positions of political power, and who are scholars of the reading process. This assertion has been made so often and with sufficient authority that it has been accepted as fact: we do have a reading problem.

The development of effective components of reading instruction proceeds through two paths. The first of these, shown in the top row in Figure 5, involves the research necessary to develop communicable, internally consistent, data based, and predictive models to be used as the basis for inventing and testing prototype instructional procedures, materials and equipment.

The literature search and synthesis effort (detailed in Chapter V) will have: (1) identified all of the existing models of reading, learning to read, and language development related to reading; (2) analyzed each model to determine its component elements; (3) synthesized those models which have common elements; (4) identified the facts about each remaining model that can be said to be empirically established; and (5) describe the research efforts that need to be made to develop each model to the point that it has utility for the invention of instructional procedures and materials. Those proposed research efforts are the focus of Activity 2 in Figure 5.

To conclude that Activity 2 work is completed on a model, the following criteria must be met. A model must be:

1. Communicable (Other Researchers must be able to obtain the model and through examination of it without its developer or originator present, achieve a common understanding of its structural and process elements.)
2. Internally Consistent (Interpretation and/or descriptions of a model should be possible without equivocation regarding the presence or absence of a structural element and without variation in process

routines. Given one set of factor values about a model's structure and process, only one model output should be calculable.)

3. Data Based (Each of the structural and process elements of the model must be grounded on empirical studies which establish their existence and set quantitative descriptions for them.)
4. Predictive (When a model is operated it must produce data that agree with the real world operation of the phenomena it represents both in terms of process and product. A model should also facilitate the identification of hypotheses about further development of the phenomena it represents.)
5. Different from others which have already passed this decision point (This criterion is an economic one. It states simply that program funds should be allocated for the development of models that have differing structural and process elements rather than for models with generally similar structure.)

Once research and model development efforts on a given model have progressed to the satisfaction of the criteria stated above, work can be funded on it under Activity 3 (Figure 5). This does not mean that all Activity 2 efforts are terminated at that point in time. On the contrary efforts on models of other relevant phenomena or models on the same phenomenon but of different structure (and process) must be continued until Phase III criteria have been satisfied and until a complete instructional system (Phase III) has been proven effective.

Activity 3 of Phase 2 involves the use of a developed model for the invention of workable components of an instructional system. Three possible foci are seen for Activity 3 as shown in Figure 5. These three are set by the conditions that might prevail at any point in time: (1) a model of the reading process might exist; (2) a model of the learning to read process might exist; and (3) both types of models might exist. The invention work in Activity 3 differs depending on these circumstances. The product of Activity 3 does not vary, however. Output from this activity will be instructional procedures and/or materials that have been empirically demonstrated in at least one instance to be effective for increasing functional reading competence. Such an increase may occur on behalf of a subset of the population or a subset of the behaviors involved in functional reading competencce. Such items are to be presented along with empirical data regarding their accomplishment. They will then be ready for independent confirmation (Activity 4) to be described below.

Concurrent with the Phase II activities described above, systematic efforts to improve a variety of existing reading instructional practices will be undertaken (labeled Adaptive Experimental Laboratories-AEL's-and shown as the bottom line in Figure 5). These projects will involve ongoing

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR

PHASE 2 --SUBOBJECTIVES & CRITERIA

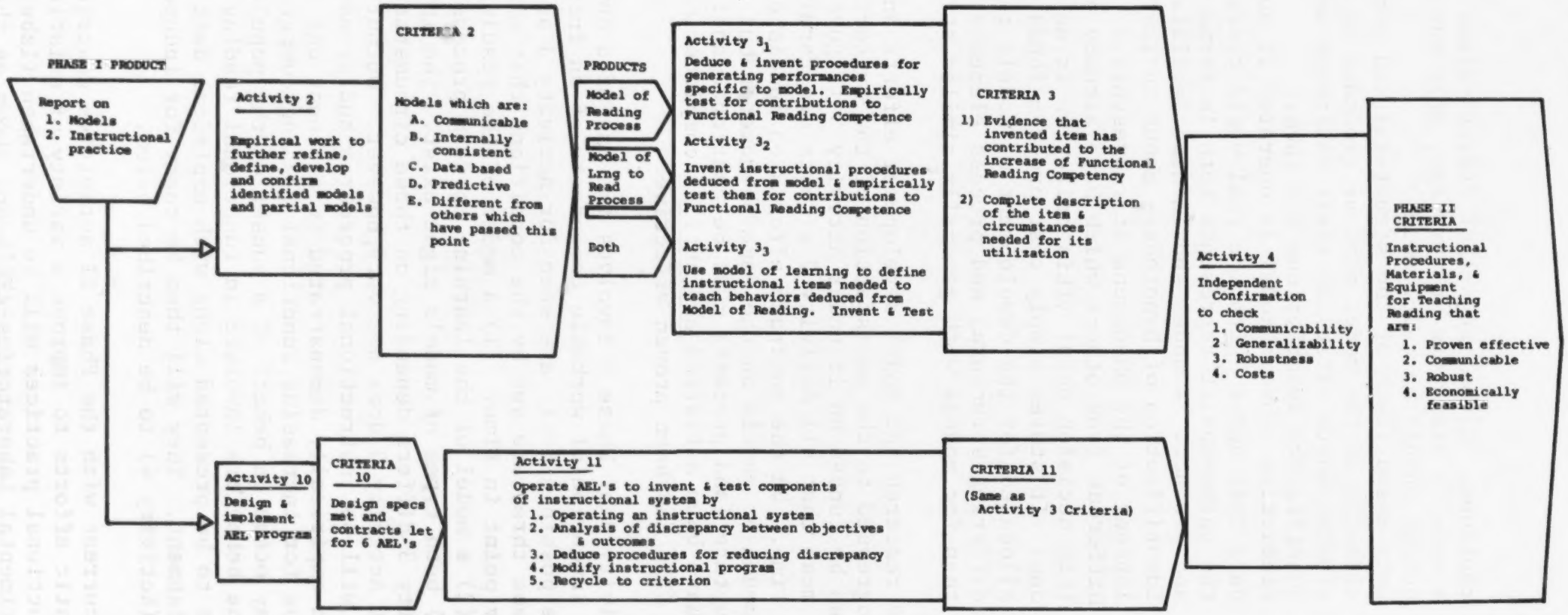

PHASE I PRODUCT
Report on
1. Models
2. Instructional practice
Activity 2
Empirical work to further refine, define, develop and confirm identified models and partial models
CRITERIA 2
Models which are:
A. Communicable
B. Internally consistent
C. Data based
D. Predictive
E. Different from others which have passed this point
PRODUCTS
Model of Reading Process
Model of Lrng to Read Process
Both
Activity 3₁
Deduce & invent procedures for generating performances specific to model. Empirically test for contributions to Functional Reading Competence
Activity 3₂
Invent instructional procedures deduced from model & empirically test them for contributions to Functional Reading Competence
Activity 3₃
Use model of learning to define instructional items needed to teach behaviors deduced from Model of Reading. Invent & Test
CRITERIA 3
1) Evidence that invented item has contributed to the increase of Functional Reading Competency
2) Complete description of the item & circumstances needed for its utilization
Activity 4
Independent Confirmation
to check
1. Communicability
2. Generalizability
3. Robustness
4. Costs
PHASE II CRITERIA
Instructional Procedures, Materials, & Equipment for Teaching Reading that are:
1. Proven effective
2. Communicable
3. Robust
4. Economically feasible
Activity 10
Design & implement AEL program
CRITERIA 10
Design specs met and contracts let for 6 AEL's
Activity 11
Operate AEL's to invent & test components of instructional system by
1. Operating an instructional system
2. Analysis of discrepancy between objectives & outcomes
3. Deduce procedures for reducing discrepancy
4. Modify instructional program
5. Recycle to criterion
CRITERIA 11
(Same as Activity 3 Criteria)

Figure 5

reading instructional programs augmented by reading and evaluation expertise. The operational procedure of AEL's will include:

1. Specification of the behaviors to be produced via instruction;
2. Observation and recording of instructional processes used;
3. Measurement of outcomes;
4. Analysis of the discrepancy between behaviors sought and the outcomes;
5. Modification of the instructional program based on this analysis; and
6. Recycling until the program standard is met.

Success in either the model or adaptive experimentation line yields a prototype. Its effectiveness must be subjected to independent confirmation before the phase is complete. This confirmation activity is shown as Activity 4 in Figure 5. Confirmation tests will provide data which will:

1. Ascertain the degree to which it is possible to communicate the procedure and materials to other practitioners;
2. Document the utility of any instructional procedure or materials to increase functional reading competence in settings and with personnel other than those of the developer;
3. Assess the robustness of the procedure or materials by trials in settings which display characteristics other than those in the site in which they were developed; and
4. Accumulate data from which to assess economic feasibility.

These confirmation tests are the final activity in Phase II. Products which satisfactorily meet the criteria for this phase will be components for an instructional system of proven effectiveness for the increase of functional reading comptetence. It is not likely that any single component coming out of this phase will do all that is necessary for achieving the program goal. Thus, the Phase II products are to be accumulated until the program managers and most recent planning team are convinced that a sufficient quantity and variety of products are available. At such a time Phase III is to be initiated.

Phases III-V: Instructional System Design and Delivery

Successful completion of Phase II occurs when proven effective components for an instructional system have been developed. The integration of those components into an effective instructional system, the development of the means for the delivery

of that system, and the selection of implementation strategies comprise the remainder of the program. Details, that is, specific projects for these phases cannot be specified until progress in Phase II is apparent. Their general nature was examined by the planning team and are discussed below. Examples of activities in these Phases are shown in the Appendices.

The design and testing of an instructional system (Phase III) presumes that an array of effective system components will have been created. Two types of problems are forseen. Some of the components are likely to be alternatives for attaining a single element of the program goal. Different combinations of such alternatives must be explored to determine overall effectiveness and to eliminate debilitating interactions. The second problem centers on optimal sequencing of the system components.

The term "system" in this program has the meaning explicated by Hills.[1] He indicates that many persons incorrectly perceive a system as a thing and asserts greater utility to the term if its referent were "...simple order, regularity, interdependence, or relatedness."[2] Hills specifies three components of the concept of system: selectivity, abstraction, and system state, each of which must be attended to in fully defining a system. He uses the pendulum to illustrate the selectivity component. A large variety of properties may be used to describe a pendulum: color, size, weight, composition, shape, temperature, position, density, etc. If, however, an individual is interested in describing the order (system) which encompasses the swing of a pendulum, only two properties are relevant.[3] In describing and designing a reading instructional system Hills' arguments imply that one must first determine the product that is of interest, in this case functional reading competence, and then ascertain the properties that are necessary for describing the order from which that product emanates.

The component of abstraction "...implies that (in a system) entities are treated in terms of their common rather than their unique properties."[4] while the system state component implies that the entities involved in a system can exist in

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[1]R. Jean Hills, "The Concept of System." Eugene, Oregon: Center for the Advanced Study of Educational Administration. 1967. (ERIC Document Number ED 014 786).

[2]Ibid. p. 2.

[3]Ibid. p. 4.

[4]Ibid. p. 4.

different combinations and interactions at different points in time.

Hills presents two ways of describing a complex system, by its structural units and by its process units.[5] The first of these typically consists of physical entities and their patterned relations. The second encompasses actions, activities, and constructs, e.g., motion and momentum. A complete system description must encompass both structural and process elements.

The application of these points to Phase III of the TRDPR calls for the following:[6]

1. The use of the program goal and the instrument(s) developed in Phase I and II as the specification of the function to be served by the reading instruction system.
2. The development of several ideal instructional systems for attaining this function.
3. The gathering of information related to the existence of and functional capabilities of the structural and process elements of those ideal system.
4. The generation of alternatives where the gathered information indicates that component elements are missing.
5. The selection of a workable instructional system by making decisions on each of the alternative elements which can be assembled to meet the program goal. These decisions will involve trade-offs on the various cost effectiveness criteria related to the instructional achievement of the goal.
6. The assembly and optimization of elements of the system.
7. Review of the system to determine the compatability of the assembled elements.
8. Test operation of the instructional system to provide an empirical check on its wholeness and workability.
9. Install and operate the instructional system in settings representative of those in which the target population reside.
10. Establish figures descriptive of the output and operation of the instructional system to serve as guidance for others who will operate it in ongoing institutions.

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[5]Ibid. p. 8.

[6]The steps outlined here are paraphrased from the work of Gerald Nadler, "Systems Engineering and Concern for People: Compatible or Contradictory?" from AIIE National Conference. May 14-16, 1969. Houston, Texas: Richard D. Irwin, Inc.

These steps are stated sequentially. However, there is an inherent iterative nature to them in operation. At times one of them will produce information that requires movement backward or forward in the listing above. It should be recognized that research activities are involved in step 3 and may be required in others. When all of these steps are completed and empirically tested on a sample of settings which accurately represent the environment of the target population, an instructional system will exist which will achieve the program goal. It is recognized that such a system will have a variety of branches some of which will be appropriate for all of the target population and others which will be followed by specified subsets of the population.

Once an effective instructional system has been generated, the concentration shifts. Here, in Phase IV, the work focuses on those materials and approaches that are necessary to make the instructional system operational and transportable. Questions in this Phase include means for producing the necessary materials and equipment and for developing the local staff expertise for operating the instructional system. Again, Hills' discussion of "system" is helpful. In Phase III the work is concentrated on the creation of an instructional system through which all ten year olds will achieve functional reading competence. Phase IV concentrates on a broader system, one which includes as parts of its structure: personnel, materials, and facilities that make possible the efficient operation of the instructional system, and, as a part of its process: those actions, activities, and constructs necessary. Again, developments in both structure and process areas are the focus of the work as are tests to empirically document the effectiveness of the supportive and auxillary items.

The final phase deals with implementation strategies. To this point in the program, work will have involved samples of students, teachers, and schools in a way that will attest to the generalized applicability of the instructional system and the supportive materials and procedures necessary to make it work. In a society that operates on a principle of local control of school systems, the question of implementing effective instructional systems must be considered. Strategies for widespread implementation range from passive announcement, through deliberate education of decision makers, through financial inducements for adoptees, to legislative imposition. The appropriateness of any one or combination of these strategies cannot be specified until information on the nature of the instructional system, the means for its delivery, and the political-social climate of the times is available.

The TRDPR Information System

Figure 3 and discussion above indicate the existence of a program information system that exists throughout the life of the programatic effort. Applications of the Convergence

Technique in the bio-medical field have shown the need for a program information system and some of its necessary characteristics. The need or such a system can be made by reference to Phase II of TRDPR. Investigators conducting research for the purpose of further development of models need immediate access to information generated in the Adaptive Experimental Laboratory or by other investigators working on model development. The program itself will need to collect and synthesize the findings of individual projects as those projects progress and reach completion. These syntheses must incorporate findings from projects funded as a part of the program as well as efforts independent of the program.

The needs implied above refer to the dissemination capability only. Such a capability implies storage and retrieval capability that must be made explicit. The information system must be able to store and retrieve:

1. Progress and final reports on all studies and projects undertaken as a part of the program;
2. Reports of projects conducted outside the program but on topics relevant to work it encompasses;
3. Data generated within program efforts (at times it may be to the benefit of the program to return to some earlier effort and reanalyze the data using different techniques);
4. Samples of all products developed within the program along with information describing the development of each product and specifications for its use; and
5. Information on individuals with expertise in the various areas of programatic effort.

Such an information system does not now exist although capability for numbers 1 and 2 are available in the ERIC Clearinghouse on Reading at Indiana University. To function as the TRDPR information system the ERIC Clearinghouse would have to agree to AND be funded for the establishment of the necessary selective dissemination mechanism, the storage of additional items such as products (tests, instructional manuals and materials) and data, and the program required periodic syntheses.

Other Program Elements

Figure 2 identifies two other program elements, a support program and a high risk high payoff program. The first of these is a program category reserved for studies which may be undertaken to improve some capability already in the program. For example, the work of the AEL's requires observation and monitoring of instruction. Procedures for this currently exist and can be used. A proposal to develop more efficient procedures would be considered as a part of a support program. The second is a program category that encompasses problem solution approaches

that have a logic structure different from the logic of the main program as described above. Examples of work that might be considered here are efforts at chemical transfer of reading ability from a reader to a non-reader.

SUMMARY

This planning project has developed an initial plan for the Targeted R&D Program for Reading, the goal of which is the development of functional reading competence in all ten year olds (except those in permanent care institutions). The major phases of that program are: (1) a preresearch phase in which literature searches will identify the existing models of reading, learning to read, and language development; catalogue the materials and procedures used in reading instruction; and se the rationale and specifications for the program criterion; (2) an instructional system component research and development phase featuring both the development of models of basic phenomena and adaptive experimentation in instructional settings; (3) an instructional system design and test phase; (4) a delivery system design and test phase; and (5) a phase exploring alternative implementation strategies. These phases are described in terms of their nature and rationale along with a program information system. This discussion has not made explicit program management structures and procedures necessary to conduct the programatic effort. These matters are the focus on Chapter 7 of this report.

CHAPTER III

ON MODELS AND MODELING IN READING

Models or representations of the reading and learning to read processes play a significant role in the first two Phases of the proposed Targeted Research and Development Program on Reading (TRDPR) (See Figures 4 and 5). To set a correct perspective it is necessary to discuss the concept "model" in a manner which answers the following questions.

1. What is a model?
2. What is the utility of a model?
3. What criteria must a model meet to realize its potential utility?
4. What are the phenomena on which TRDPR modeling efforts will focus?
5. What categories of research on existing models of these phenomena need to be undertaken to achieve the criteria identified in the discussion of question 3?

Before discussing these questions several points need to be made. The TRDPR plan assumes that partial and partially developed models of reading and of learning to read currently exist; that many of the models described in the literature are different only in the language used to express them; that not enough research has been done to specify the structure and operation of the extant models; and, that in their present state they are relatively useless as a basis for generating reading instructional systems. One line of the TRDPR program proposes: (1) that the extant models (including partial models) be identified and expressed as completely and clearly as possible given the present state of knowledge (See Chapter VI); (2) that empirical research be funded which will both substantiate (or refute) the validity of these models and develop them to the point where they accurately predict reading behaviors and outcomes; and (3) that substantiated, well developed models be used as the basis for inventing instructional materials, procedures, and equipment.

What Is a Model?

A model is a representation of a phenomenon which displays the identifiable structural elements of that phenomenon, the relationships among those elements, and the processes involved in the natural phenomenon. Examples of models of the reading process can be seen in the work of Gray-Robinson[1] and Goodman.[2] The first of these is a set of ten diagrams and a written elaboration. The diagrams have the following titles:

1. Major Components of Reading
2. Diagramatic View of the Reading Act
3. Word Perception (as related to sight vocabulary)
4. Word Perception (as related to word attack skills)
5. Comprehension - Grasping Literal Meaning
6. Comprehension - Securing an expanded grasp of the meaning
7. Reacting to What Is Read
8. Fusion of Ideas Read with Previous Experience
9. Composite View of Reading Act
10. Reading for Different Purposes and in Various Fields.

Goodman's model is a verbal statement that has been displayed in a flow chart format (See Figure 6).

Examination of these two examples is helpful in answering the question, "What is a model?" First, neither of them is the phenomenon called reading. Rather they are attempts to represent the reading process. Second, each of these examples presents what are proposed as "essential elements" of the phenomenon. The Gray-Robinson model indicates that reading has the following elements, "Major Components of Reading," to use their words:

1. Word perception
2. Comprehension
3. Reaction to what is read
4. Fusion of new ideas and old

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[1]Helen M. Robinson, Sequential Development of Reading Abilities. Supplementary Education Monographs #90, Chicago: University of Chicago Press, 1960.

[2]Kenneth S. Goodman, Study of Children's Behavior While Reading Orally. Final Report USOE Project No. 5-425, Wayne State University, March 1968.

_____, "The Psycholinguistic Nature of the Reading Process." in The Psycholinguistic Nature of the Reading Process. K. S. Goodman Ed., Detroit: Wayne State University Press, 1968.

A FLOW CHART OF GOODMAN'S MODEL OF READING

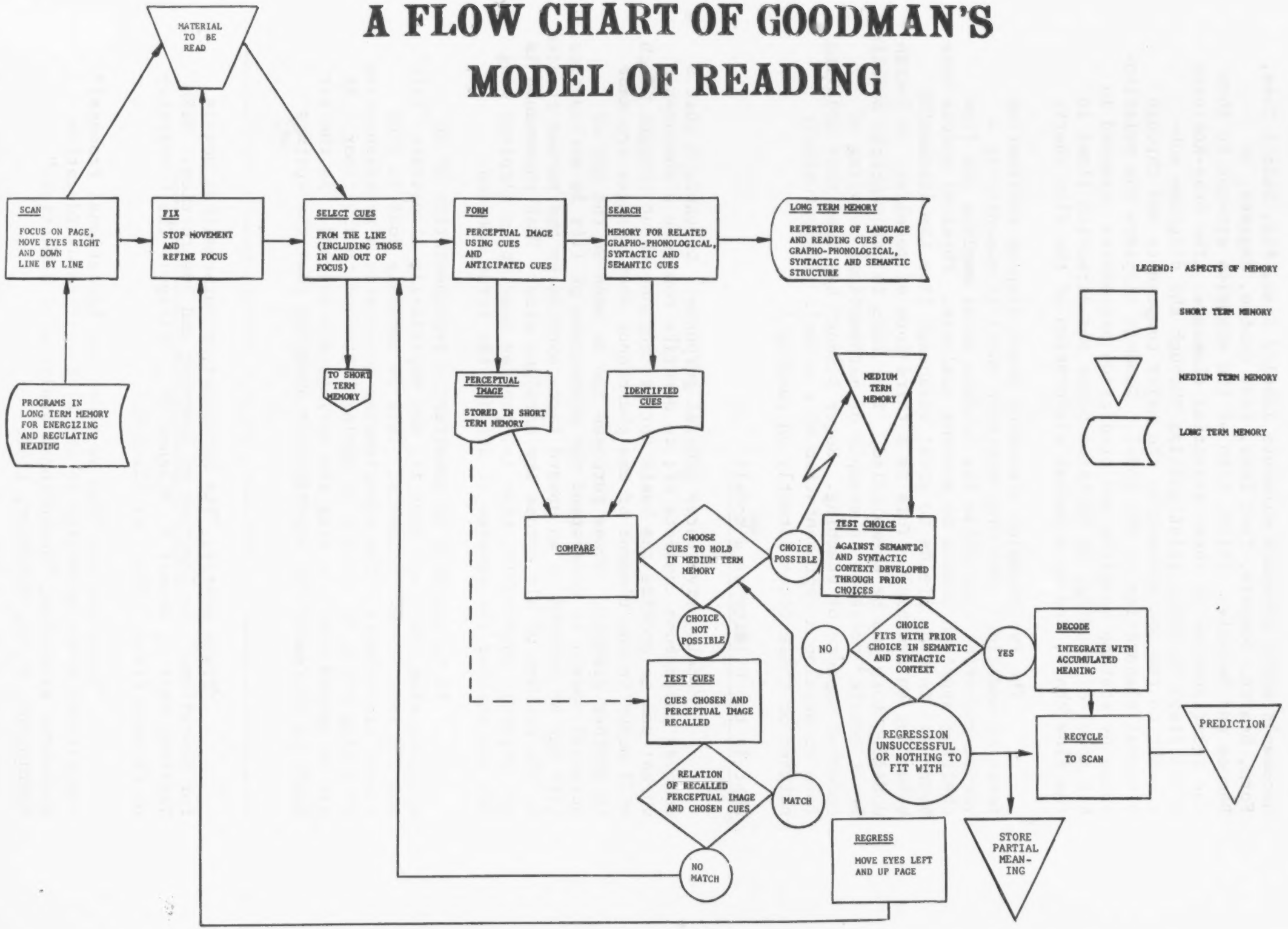
MATERIAL TO BE READ
SCAN
FOCUS ON PAGE, MOVE EYES RIGHT AND DOWN LINE BY LINE
FIX
STOP MOVEMENT AND REFINE FOCUS
SELECT CUES
FROM THE LINE (INCLUDING THOSE IN AND OUT OF FOCUS)
FORM
PERCEPTUAL IMAGE USING CUES AND ANTICIPATED CUES
SEARCH
MEMORY FOR RELATED GRAPHO-PHONOLOGICAL, SYNTACTIC AND SEMANTIC CUES
LONG TERM MEMORY
REPERTOIRE OF LANGUAGE AND READING CUES OF GRAPHO-PHONOLOGICAL, SYNTACTIC AND SEMANTIC STRUCTURE
PROGRAMS IN LONG TERM MEMORY FOR ENERGIZING AND REGULATING READING
TO SHORT TERM MEMORY
PERCEPTUAL IMAGE
STORED IN SHORT TERM MEMORY
IDENTIFIED CUES
MEDIUM TERM MEMORY
COMPARE
CHOOSE CUES TO HOLD IN MEDIUM TERM MEMORY
CHOICE POSSIBLE
TEST CHOICE
AGAINST SEMANTIC AND SYNTACTIC CONTEXT DEVELOPED THROUGH PRIOR CHOICES
CHOICE NOT POSSIBLE
TEST CUES
CUES CHOSEN AND PERCEPTUAL IMAGE RECALLED
RELATION OF RECALLED PERCEPTUAL IMAGE AND CHOSEN CUES
MATCH
NO MATCH
NO
CHOICE FITS WITH PRIOR CHOICE IN SEMANTIC AND SYNTACTIC CONTEXT
YES
DECODE
INTEGRATE WITH ACCUMULATED MEANING
REGRESSION UNSUCCESSFUL OR NOTHING TO FIT WITH
RECYCLE
TO SCAN
PREDICTION
REGRESS
MOVE EYES LEFT AND UP PAGE
STORE PARTIAL MEAN-ING
LEGEND: ASPECTS OF MEMORY
SHORT TERM MEMORY
MEDIUM TERM MEMORY
LONG TERM MEMORY

Figure 6

Goodman's model presents elements labeled Scan, Fix, Select Cues, Form, Search, Compare, Test Cues, Test Choice, Regress, or Decode and Recycle. Third, both of the examples attempt to show the relationships of these essential elements. The Gray-Robinson model displays these relationships through the diagrams subsequent to the one presenting the major components and through a verbal elaboration of the model. Goodman displays the relationships by stating sampling and prediction procedures assumed in his model of reading, by decision boxes and direction lines in the flow chart, and by a verbal elaboration of the flow chart.

The two examples presented above display contrasting forms of modeling. The Gray-Robinson model is essentially a verbal-pictorial form while the Goodman model employs the flow charting approach common to systems analysis. Physical models have been used in many fields to great advantage (See the discussion below for an example). This is a third form of modeling. A fourth modeling form can be exemplified. That form is mathematical modeling. Frank Restle[3] presents an example of mathematical modeling of selected aspects of teaching. Roger Sisson[4] has used this modeling form to develop a representation of a school. (Unfortunately neither of these focus directly on reading.)

What Is the Utility of a Model?

Models serve three general purposes: to explain what a complex phenomenon consists of; to describe how such a phenomenon works; and to provide the basis for predictions about changes which will occur in one element of the phenomenon when changes are made in another element. These purposes can be seen in the use of physcial models to understand the phenomenon of lift in aeronautics. Lift can be defined as an upward force exerted by the vacuum created by the passage of air across the airplane wing. That phenomenon is not directly observable; that is, one can look at an airplane wing and see neither the passage of air nor the force exerted.

It is possible to construct a representation of an airplane wing, pass air over it, and empirically illustrate "lift" and its constituent elements. This is commonly done in wind tunnel experiments. The experimenter constructs a representation of a wing which he fastens to springs attached to the floor. As air is passed over the wing the springs are watched. As the air speed is increased the experimenter observes that the springs

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[3]Frank Restle, "The Relevance of Mathematical Models for Education." in Theories of Learning and Instruction. NSSE Yearbook Part I, Ernest R. Hilgard Ed., Chicago: The University of Chicago Press, 1964. p. 111-132.

[4]Roger Sisson, "Can We Model the Educational Process?" Unpublished mimeo presented to the U. S. Office of Education sponsored symposium, "Operational Analysis of Education." Washington, D. C., November, 1967.

stretch. Thus, the apparatus enables a direct observation of a phenomenon that typically cannot be observed, an observation that is not possible if any of the crucial elements are missing.

The same apparatus can be used to illustrate the second purpose of models--to show how a phenomenon works. If some colored smoke or small particles are introduced in the wind stream and pictures taken, the path of the air molecules can be approximated. Analyses of these pictures would indicate that the air passing over the top of the wing travels a longer route than the air passing directly under the wing. This differential rate causes a lessening of pressure on the top in comparison to the bottom. The wing rises when this difference is large enough to overcome its weight.

The third purpose for models, prediction, can also be seen in the wind tunnel apparatus described above. The speed of the wind, the attitude and shape of the wing and the expansion of the spring can be quantified. Repeated observations produce data which have made possible the derivation of formulas for calculating lift if wind speed and wing shape and attitude are known. Once this level of modeling is achieved further experimentation can be conducted through mathematical manipulation alone.

Models of the reading process have been used to explain what the phenomenon consists of and to suggest how it works. To date models of reading have not been developed to the state which permits keeping the determination of the cruciality of identified elements or quantitative predictions to be made. When models achieve a stage of development which facilitates prediction, they serve more effectively as aids in studying the phenomenon, as the basis for work which tries to improve understanding of the modeled phenomenon, and engineering of better products based on new knowledge about the phenomenon.

What Criteria Must a Model Meet to Achieve Potential Utility?

Before dealing directly with this question it is important to distinguish between several types of modeling. The first of these is modeling by example. At times one attempts to explain what a phenomenon is by pointing to an instance of it. We sometimes call attention to an individual and state, "He is a model..." Such modeling is not very useful as it calls attention to the locus of the phenomenon rather than to its details. This type of modeling is not what is intended in the model development and refinement research included in the TRDPR program.

Analogous modeling is the second type. In this case a representation of the phenomenon is constructed which displays a similarity in output without identity between the elements of the model and the phenomenon. Isomorphic modeling is the third type. In this case, one to one correspondence is demonstrated

between each element of the model and each element of the phenomenon modeled.

Isomorphic modeling is preferred over analogous modeling. It is possible to operate an analogous model and produce output equal to that observed in the real phenomenon without displaying the elements or the processes of the phenomenon.

Criteria for adequacy in model development for the TRDPR program are:

1. Communicability - different scientists must display consistency in describing the elements of the phenomenon and their relationships, and a second scientist can get the same results as a first in applying the model to a specific set of data.
2. Internal Consistency - multiple conclusions cannot be generated when the same set of data is operated upon in the model.
3. Data Based - the model's elements and their interrelationships are documented through empirical studies.
4. Predictability - the elements of the model and their interrelationships have been quantified and formulae generated which provide the means for predicting performances that agree with real data.
5. Generality - applicability is certified in instances beyond those in which it was developed.

When models of the reading process and the learning to read process reach these criteria, it should be possible to delineate the behaviors involved in them and deduce the instructional materials and procedures necessary to develop those behaviors.

Phenomena Central to TRDPR Modeling Efforts

The planning team concentrated its discussion on three phenomena when examining the theoretical base necessary for the design and invention of components for an instructional system for functional reading competence. Those phenomena are:

1. READING PROCESS--the interrelated series of steps operations or activities of a linguistic, physiological, cognitive, perceptual, and psychological nature that come into play when the organism engages in reading behaviors defined as covert responses to verbal written language (Covert responses which are indicated by overt performances which could not have occured without the covert responses to the written language).

2. LANGUAGE DEVELOPMENT RELATED TO READING--the expansion of the individual's semantic, syntactic reservoir as instruction in graphophonological translation of written language to sound and meaning is provided.
3. LEARNING TO READ PROCESS--the interrelated steps, operations or activities through which the individual moves to achieve functional reading competence.

Categories of Research Needed to Meet the Criteria for Model Adequacy

Examination of the research literature on reading to date has identified only partial models of the reading and learning to read processes. These models are partial in either of two senses: first, some of the models do not attempt to represent the entire process; second, those models that try to incorporate all aspects of the process have not been developed to the stage of predictability described in the criteria above. The recognition of these two kinds of partiality sets up four categories of models as shown in Figure 7.

ANTICIPATED CATEGORIES OF MODELS

Model Development State	Phenomenon Inclusiveness: Part of Phenomenon	Phenomenon Inclusiveness: All of Phenomenon
Verbal-Pictorial Representation	A	B
Mathematical Representation	C	D

Figure 7

Part of the TRLPR plan calls for work which starts with these partial models and moves to (1) their synthesis where possible, and (2) to their further development and refinement or refutation. To do so seems to require five categories of empirical studies.

1. Studies which support (or reject) the combination of two or more partial models. Such combination might involve the synthesis of a number of partial models into one comprehensive model, the combination of several comprehensive models that are different only in vocabulary, or both. Such combinations

will have been suggested on a logical basis in the previously mentioned literature search effort. These combinations must be tested empirically before further work is undertaken to document the logic of the combination.

2. Studies which test hypothetical elements of identified models. The literature search activity will classify all research conclusions in the literature into four categories: Conclusions generated via: (1) sound methodology and verified; (2) sound methodology and rejected; (3) questionable methodology; and (4) stated but not empirically tested. The latter two categories must be tested by sound empirical techniques before the model can be accepted as a definitive representation of a process.
3. Studies which define and depict constructs in the models. Literature on reading proposes many constructs which on the surface have striking similarity; Gage[5] cites the following as an example: reading readiness, entry behaviors, and pre-existing cognitive set. Many take these terms as synonyms. Careful analysis indicates that there are common and uncommon elements to them. Their differences and similarities have not as yet been explored empirically, a task that must be completed if models are to be further developed.
4. Studies which fix "factor values" for the elements of a model and which determine their "calculus-of-operation." Operational prediction requires quantification of the constituent elements of a model and generation of formulas descriptive of the functioning of those elements.
5. Studies which establish the predictive capability of a model. If a predictive model has been generated its validity must be established by comparison of its output with real data. That is, it should be possible to operate the model and produce output that agrees with observable output when the phenomenon itself is in process.

The five types of research described above should produce models which provide a basis for inventing instructional procedures, approaches, materials, and equipment.

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[5]N. L. Gage & W. R. Unruh, "Theoretical Formulations for Research on Teaching." Review of Educational Research 37:358-370; June, 1967. p. 366.

CHAPTER IV

THE PROGRAM GOAL AND STANDARD

The title of this chapter implies a distinction between the terms "goal" and "standard" which needs to be made explicit. In the discussion which follows the term "goal" refers to the conditions which must obtain when the program is complete: that is, 100 per cent of all people (not in permanent care institutions) over 10 years of age can complete 90 per cent of the items on a test of functional reading competence. Standard has as its referent the tasks alluded to in the goal and the performance level sought. It is in effect a subelement of the goal.

The program goal has four subelements that need to be made explicit.

1. Population - the concentration is on those persons moving through the schools in the future. That is, the objective is to be met by constructing a system which will assure a level of reading competence for all children by age 10 which, given continued schooling, will lead to competence in performing specified adult reading tasks. A second aspect of the population statement is the exclusion of those whose pathological conditions such as mongolism or frank brain damage would demand reading instruction that is grossly cost-inefficient.
2. The second element of the goal is a set of tasks that exemplify reading competence. It is recognized that reading competence is variable and that the program objective concentrates on a point on the scale describing that variable. It is asserted that neither that point nor the scale have been established by existing work. Therefore, a part of the main program will concentrate on the development of the functional reading competence standard for the program goal.
3. Performance level - the goal statement implies two concerns here. First, that mastery (90 per cent correct performance) be attained. Second, that that performance level be retained. The latter is what is implied by the phrase "over 10 years of age."

4. Resources - although not explicity stated, the program objective has a resource constraint. A cost ceiling is to be specified in terms of what society is willing to pay for the performance implied by the goal statement.

The goal of the TRDPR plan is functional reading competence for all persons reaching age 10. But the questions, "What is Functional Reading Competence?" and, "Is there a problem? must be faced before the program should be fully implemented.

Many statements have been made which assert that our society has a reading problem. These assertions have been made with sufficient authority and frequency that they have been accepted as fact: a reading problem exists. What is the desirable level of reading competence to be achieved by the individual in our society? Even more basically, what level of reading competence is necessary to function in our culture? Neither of these questions has been answered on either an empirical or logical basis. Reading and reading achievement have been the target of many measurement efforts over the years, but the data produced through these efforts does not answer the two questions cited above. These measurements do not tell us what competence is desirable nor do they state a minimum standard. They are in fact not referenced to a level of competence but rather to comparison of individuals. John Carroll highlights this difficulty as he cites one of our problems as:

> "...the failure to specify in tangible terms the actual referents of results of educational and psychological measurements. Instead of attempting to state these meanings in something approaching absolute terms, we resort to the use of relative terms. We report percentiles rather than behavior. We report central tendencies without describing the corresponding points on the statistical continuum.[1]

In the years since that statement was made most measurement in reading has continued to be done through the use of norm referenced tests. We learn from these measures how an individual ranks among some population but we do not learn what behaviors he can perform. A 6.0 reading score does not tell how fast a given written statement can be read nor what comprehension level can be expected on that passage. It tells us that this child reads as well as most entering sixth graders.

Ralph Tyler says:

> The kind of assessment which can be useful to the

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[1]John B. Carroll, "Neglected Areas in Educational Research," Phi Delta Kappan 42:339-46; May 1961.

> teacher (or curriculum developer, researcher, etc.) is a set of exercises which samples the basic ideas at the simplest level, which is quite a different thing from the common achievement test that we have been using.[2]

There have been some attempts in recent years to develop criterion referenced measures of reading the type alluded to by Tyler. Such tests are designed to specify behaviors that comprise the phenomenon being tested and assess competence in the performance of those behaviors. One well known test is purported to measure "...five major reading-for-comprehension skills": the ability to (1) recall ideas; (2) translate ideas and make inferences; (3) analyze motivation of the writer; (4) analyze a presentation; and (5) constructively criticize.[3] However, this breakdown of reading is the product of logical efforts of a committee of authorities. As one reviewer says, "With all due respect for the committee, it would be highly desirable to have their judgments tested and supported by empirical evidence."[4] Another test listed as a diagnostic instrument is described by a reviewer as:

> ...designed to appraise reading abilities at all grade levels from kindergarten through the college freshman year. The basic plan for each battery includes a separate survey test designed to appraise a pupil's general reading proficiency and a number of supplemental tests for appraising specific reading skills.[5]

Such an instrument would be precisely what is needed to measure reading competence if it were not for two factors recognized by the reviewer: first, "...the lack of readily available information about the validity and reliability of this battery and its subtests."; and second, the scores on the test are reported in percentiles, a means of reporting which does not display what skills a child has but rather how he compares with others.

A few tests have been developed to measure progress in learning to read. However, these have not been developed in

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[2]Ralph Tyler, "The Purposes of Assessment." in Improving Educational Assessment & An Inventory of Measures of Affective Behavior. Walcott H. Beatty, Ed. Washington, D. C.: Association for Supervision and Curriculum Development, NEA, 1969.

[3]O. K. Buros, (Ed.), Reading Tests and Reviews. Highland Park, New Jersey: The Gryphon Press, 1968. p. 327.

[4]Ibid. Paul R. Lohnes (Reviewer) p. 327.

[5]Ibid. Albert J. Kingston (Reviewer) p. 343.

a way which enables a response to our questions about either a desirable or minimally required level of reading competence. These tests have been structured by examining conceptions of sequential patterns through which children learn to read, not by an examination of the reading tasks encountered in our culture.

An analogy may be helpful in making clear the focus of the proposed program standard development work. A criterion referenced test has been developed for assessing swimming competence. It consists of statements of skills that must be achieved enroute to the desired behavior, swimming. Examples of those enroute skills are: places face in water; opens eyes under water; bobs up and down inhaling above the water and exhaling below the surface; places face in water, exhales, rotates head to bring mouth above water surface and inhales; coordinates this breathing pattern with arm strokes; etc. Each of these activities is a skill that must be accomplished as a part of the overall behavior.

Swimming behavior is not a constant. It can range from performance which wins Olympic medals to the bare ability to keep oneself afloat and move through the water. In setting the tasks in the Red Cross Swimming Test some point on that range had to be selected as the desirable standard to be attained. That point has been set by an analysis of the behavior and circumstances durrounding the performance level demanded in normal life experiences. The measuring instrument, the list of sub-tasks, was then developed in a manner which predicts behavior in those normal life experiences involving swimming and provides a basis for further independent development through practice.

Reading competence is similarly a complex variable with a considerable performance range. The TRDPR program asserts that those reading tasks encountered in adult life need to be delineated; that those deemed necessary for all persons must be specified; that behaviors to be mastered by ten year olds which predict successful performance in the required adult reading tasks must be identified; and, that instrumentation must be developed to determine whether a given ten year old can perform these behaviors.

Initial thinking on the part of the TRDPR planning teams had a very direct instrument development focus. As discussions progressed, activities prior to instrument development were identified and stated as part of the program plan. These preliminary activities constitute an attempt to develop a rationale and set of specifications for the measurement of the program standard. These preliminary activities, as currently conceived, are guided by the idea that if ten year olds pass the program standard they will have the basic skills that will enable them, with exposure to further schooling, to refine and

expand their reading achievement so that they can participate eventually as "reading adults" in society. In other words, those skills developed by ten year olds will be predictive to future development but will not necessarily encompass the development.

To develop the necessary rationale and specifications the tasks shown in Figure 8 have been identified.

MEASUREMENT RATIONALE DEVELOPMENT TASKS

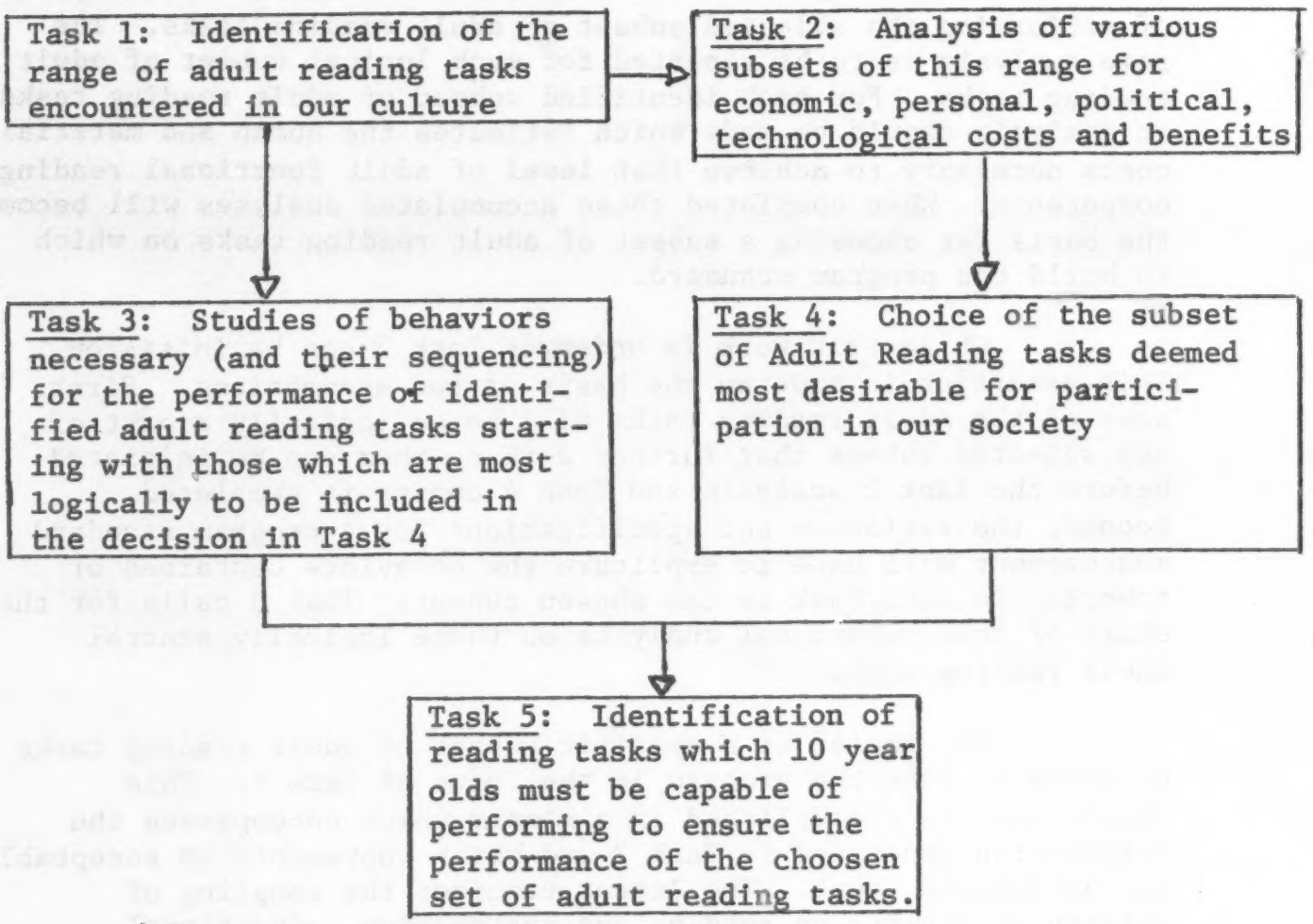
Task 1: Identification of the range of adult reading tasks encountered in our culture
Task 2: Analysis of various subsets of this range for economic, personal, political, technological costs and benefits
Task 3: Studies of behaviors necessary (and their sequencing) for the performance of identified adult reading tasks starting with those which are most logically to be included in the decision in Task 4
Task 4: Choice of the subset of Adult Reading tasks deemed most desirable for participation in our society
Task 5: Identification of reading tasks which 10 year olds must be capable of performing to ensure the performance of the choosen set of adult reading tasks.

Figure 8

Task 1 calls for a cataloguing of adult reading tasks. As asserted earlier this work has not been accomplished. It must include more than what is encountered in studies focused on reading for survival. And, it must have an empirical referent not found in hypothetical discussions of the "perfect reader." Task 1 asks for a collection and cataloguing of reading tasks with which adults are confronted.

Once this range of reading tasks has been specified, two tasks may be undertaken simultaneously. These are identified as Tasks 2 and 3 in Figure 8. It is not conceiveable that functional reading competence for adults would encompass all of the identified reading tasks. This is both humanly and financially impossible. Clearly, some subset of this range of

reading tasks will have to be identified as to what is desired as adult functional reading competence. Selection of that subset cannot be arbitary. Rather, that selection should be based on the analysis of the economic, personal, political, and techonological costs and benefits of several subsets. Task 2 calls for this analysis. This work starts with the total list of adult reading tasks and proceeds through the identification of logical subsets of that list. Each subset must then be analyzed as if it were the level of adult functional reading competence sought through the TRDPR. This analysis should estimate the benefits to individuals and to society which would occur if all adults were capable of performing the selected subset of adult reading tasks. The same analysis is to be repeated for each logical subset of adult reading tasks. For each identified subset of adult reading tasks an analysis should be made which estimates the human and material costs necessary to achieve that level of adult functional reading competence. When completed these accumulated analyses will become the basis for choosing a subset of adult reading tasks on which to build the program standard.

While this work is underway Task 3 can be initiated. This assertion is made on the basis of two assumptions. First, some of the adult reading tasks will be so logically a part of any selected subset that further work on them can be initiated before the Task 2 analysis and Task 4 choice is completed. Second, the rationale and specifications for a program standard measurement will have to explicate the behaviors contained or inherent in each task in the chosen subset. Task 3 calls for the start of this behavioral analysis on those logically central adult reading tasks.

The choice of a specific subset of adult reading tasks on which to base the program is the focus of Task 4. This choice must be accomplished in a manner which encompasses the information generated in Task 2 and which represents an acceptable and achievable goal. The latter requires the sampling of opinion of experts on reading and instruction, educational decision makers, practitioners, and the lay public. The goal here is the identification of a set of reading tasks which provides the greatest personal and social benefit and for which society is willing to pay for.

Task 5 in Figure 8 calls for the continuation of the Task 3 work, that is, the behavioral analysis of the selected subset of adult reading tasks. This analysis will serve as the basis for identifying reading tasks which ten year olds must be capable of performing to enable the development of the required adult reading behaviors. The items derived from Task 5 set the nature of the measurement development activities structured as a part of Phase II.

The general objectives and rationale for the measurement of functional reading competence will be set through the activities described above. That effort will serve as the basis for instrument development procedures to be implemented early in Phase II of the Targeted R&D Program on Reading. Decisions made to this point indicate that the instrument to be developed should be a criterion referenced rather than norm referenced. Data from its eventual administration must yield information which indicates what reading behaviors a measured subject is capable of. The program purposes will not be served by instrumentation which states only how a measured subject ranks with others. Previously made decisions and the work to be done in Phase I specify the criterion, those reading behaviors involved in performing a selected set of adult reading tasks.

The measurement procedures to be developed in Phase II have a dual focus. They are to be administered to children reaching age ten and indicative of behaviors of which adults are to be capable. The field of measurement has to date indicated that another dichotomy must be considered. In some cases measurement focuses on actual behaviors while in others the focus is on constructs. The recognition of age and item measured dichotomies leads to a grid which helps to clarify the focus of the program criterion sought in the Targeted R&D Program for Reading.

PROGRAM CRITERION FOCUS

Items to be Measured

Age	Constructs Involved in Reading	Actual Behaviors in Reading
Adults	A	B (Must be identified)
Children Age Ten	D (May have to be used)	C (Desired focus)

Figure 9

The work to be undertaken starts with cell B, the actual behaviors of adults in performing a selected set of reading tasks. These must be determined. The items in cell C are those which must be mastered by children reaching age ten to assure that they will be capable of the behaviors in cell B when they reach adulthood. These items are the desired focus of the program criterion. It is recognized that cell D, constructs involved in reading by children, may have to be settled for at the outset. If this is the case subsequent planning teams must attend to the efforts needed to obtain measures that have a cell C focus.

Activities for developing the measuring tools necessary in the Targeted R&D Program on Reading must follow sound measurement procedures explicated in numerous measurement texts. Extrapolation from the procedures followed in Thorndike's report of the development of measures for the International Mathematics Study[6] identifies the following steps to be followed in the TRDPR instrument development activities:

1. Develop detailed specifications for the measurement. These specifications must take into account the measurement purpose, the subjects to be tested, the general content to be measured, and the conditions under which the instrument is to be used.
2. Delineate the content of the behaviors to be measured. This work will have been stated in the Phase I activities which specify the set of adult reading tasks which serve as the ultimate program goal. It will involve the determination of the behaviors necessary to perform those reading tasks and the determination of reading behaviors ten year olds must be able to perform which will make possible (with additional schooling) the performance of those adult reading behaviors.
3. The identification of any sequence that may be inherent in the reading behaviors ten year olds must be able to perform.
4. The identification of observable indicators of those behaviors derived from the adult reading task descriptions.
5. The generation of stimuli which can create those observable indicators.
6. The delineation of the range of variability for each indicator.
7. The development of scales for identified variability.
8. The validation of these measures on a sample representative of the target population in the TRDPR.
9. Trial use of the instrument(s) involving samples of subjects AND individuals to be involved in future administrations.
10. The preparation of technical reports on the measurement tool(s) including:
    a. Rationale
    b. Technical data on validity and reliability
    c. Instructions for administration and interpretation.

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[6]R. L. Thorndike, "The Mathematics Tests" in International Study of Achievement in Mathematics Volume I. Tortsen Husen (ed.) New York: John Wiley & Sons, 1967.

One more activity is needed in relation to the program goal and standard, the delineation of the included target population for the program. This would involve the identification of the characteristics of ten year olds and of recognizable subsets of that population. This work should concentrate on factors and variables that have known relationships with functional reading competence. This work should be started concurrent with Task 1.

The work outlined above has been detailed in a USOE Request for Proposals as follows.

1. Define and describe the recognized subgroups of subjects who comprise the target population of the program by providing explicit inclusion-exclusion criteria and identifying parameters and parameter values which differentiate the subgroups.
   This activity answers the question, "Who will be able to read when the program has satisfied its objective?"
   As originally delineated by the planning project, the target population includes all persons over 10 years of age who do not have physical or emotional handicaps which require permanent institutional care. On a logical basis, there may well be people in permanent care institutions who can learn to read (e.g., the bright but emotionally disturbed child); similarly, persons who are not permanently institutionalized may include some who cannot learn to read in the usual sense of the word (e.g., the well-adapted, self-sufficient blind person). The Contractor shall provide one hundred copies of a report which provides (a) inclusion and exclusion criteria for the target population; (b) definition and description of the major subpopulations within the target population; and (c) a rationale for the exclusion of any category of persons from the target population.
2. Identify a set of adult criterion reading tasks which adequately sample the tasks for which highly favorable returns to the individual and to society can be demonstrated and construct an assessment procedure to validate the choice of those adult reading tasks as the performance criterion dimension of the Program objective.
   This activity requires pursuit of the following general strategy:
   (a) Design an adequate plan for representative sampling of the adult population of the United States.

(b) Identify the universe of reading tasks actually performed by the resulting sample.
(c) Develop one or more schemes for classifying the universe of reading tasks.[7]
(d) Perform studies to determine the benefits which accrue to the individual and to society when adequate performance of a class of tasks can be demonstrated.
(e) Select criterion tasks which represent high-benefit classes of reading tasks.
(f) Construct an assessment procedure based on the work performed in (a) through (e).
(g) Validate the assessment procedure by testing hypotheses approximating the fillowing form: "The benefits identified in (d) for a class of reading tasks accrue to individuals who can perform the criterion tasks which represent that class."

SUMMARY

It has been asserted that a reading problem exists with sufficient force and professional backing that the point has been accepted as fact. The reading problem has not been documented empirically. This research program calls for its empirical documentation through: (1) the examination of reading tasks encountered in our culture; (2) the specification of that set of reading tasks every adult should be able to perform; (3) the delineation of reading competence that must be mastered by all persons reaching age ten in order to perform those required reading tasks as adults; (4) the development of a criterion referenced measuring instrument or instruments to assess and/or predict that mastery; and (5) periodic sampling of the population to determine the nature of our successes and failures in attaining functional reading competence.

At the risk of being pedantic it is noted that if the administration of tests designed and validated as measures of the ability of individuals to perform specified reading tasks results in the conclusion that no problem exists, the program goal will have been satisfied and the programatic effort will be terminated.

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[7]Such schemes would classify reading tasks, on such bases as readability, similarity, or frequency of occurence.

CHAPTER V

LITERATURE SEARCH AND SYNTHESES ON THE PROCESSES OF READING, LEARNING TO READ, AND LANGUAGE DEVELOPMENT RELATED TO READING

(PHASE I ACTIVITY)

The specification of the research and development work that must be done to achieve a national goal of functional reading competence requires the delineation of what is known about phenomena central to functional reading competence. The quantity of research done on reading is large and as a result the body of literature is voluminous. This literature has been carefully chronicled thanks to the work of Gray and Robinson. For years these two scholars have compiled annual bibliographies of the work done on reading. Today the ERIC Clearinghouse indicates that a comprehensive bibliography on reading contains 8,000 entries. But, the existence of those items, and even their storage and careful cataloguing, does not provide the delineation of the known necessary for specification of needed research work. True, the existing collection of literature contains what is known about reading and related phenomena, but it is in bits and pieces, scattered in this article and that, in this research report and that, in this state of the art summary and that.

What is known about reading exists in the form of research findings and conclusions, logically derived assumptions, and carefully analyzed professional experience. There have been attempts to interpret what the sum total is that exists in those forms. Examples can be seen in articles in the Encyclopedia of Educational Research,[1] the Handbook of Research on Teaching,[2] and two yearbooks of the National Society for the Study of

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[1]William S. Gray, "Reading" and "Physiology and Psychology of Reading." in Encyclopedia of Educational Research. Chester Harris (Ed.) New York: The Macmillan Company, 1960. pp. 1086-1114.

[2]David H. Russell and Henry R. Fea., "Research on Teaching Reading." in Handbook of Research on Teaching. N. L. Gage (Ed.) Chicago: Rand McNally & Company, 1963, pp. 865-928.

Education.[3] Some of the summative attempts include research findings and conclusions, assumptions, and insights from professional experience. Some in fact present theories and models which purport to detail what is known about reading.

Three problems make these prior efforts inadequate for the needs of the Targeted R&D Program on Reading. First, the existing syntheses have been selective rather than inclusive regarding the literature examined. This is no criticism of individuals who have prepared such syntheses. The body of literature is so large and it has, until recently, been located in so many places that it was beyond the capability of one or two persons to obtain-let alone synthesize-all of it. Second, existing syntheses do not include a systematic evaluation of the methodological adequacy of the completed research. Third, the existing syntheses display a primary focus on reading instruction and only a secondary focus on the reading process, the process of learning to read, and language development related to reading. All thre of these difficulties must be overcome if what is known about these processes is to be delineated as the basis for the research in the Targeted R&D Program on Reading.

These problems can be solved. The literature search and synthesis task is too large for a one- or two-man effort. A project with sufficient manpower and resources must be established. The manpower needs include personnel to guide the search and synthesis, specialists in research methodology, and several reviewer-evaluators for each of the three literature searches contemplated. The role to be played by each of these categories will be made clear in the material which follows. The point to be made here is that the literature searches called for are major efforts demanding sizeable expenditure.

The second failing of existing syntheses can also be rectified. Chall[4] has provided an example of the needed procedure. Her work involved: (1) the identification of relevant work (reports of research); (2) the assessment of the methodological adequacy of that work; and (3) the synthesis of what is known based on (1) and (2). The focus of Chall's work, however, makes its summary of knowledge inappropriate for the model building activities in the Targeted R&D Program on Reading. Her book

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[3]National Society for the Study of Education Sixtieth Yearbook, 1961, Part I. Development in and through Reading. Prepared by the Society's Committee, Ralph W. Tyler, Chairman: The University of Chicago Press, Chicago, Illinois. pp. 406. _____ Sixty-seventh Yearbook, 1968, Part II. Innovation and Change in Reading Instruction. Prepared by the Society's Committee, Helen M. Robinson (Ed.): The University of Chicago Press, Chicago, Illinois.

[4]Jeanne Chall, Learning to Read: The Great Debate. New York: McGraw-Hill Book Company. 1967.

is described on the title page as, "an inquiry into the science, art, and ideology of old and new METHODS OF TEACHING children to read 1910-1965." (Emphasis added). The contents conform with this description. The targeted R&D Program on Reading needs three syntheses, the reading and learning to read processes and language development related to reading. These are quite different from METHODS OF TEACHING.

Chall's approach breaks with the traditional in her systematic analysis of the quality of the completed research prior to the synthesis. Despite the compelling argument of Monroe and Englehart[5] in 1936 few research synthesizers in education employ a stated set of criteria for determining research quality. The typical procedure seems to involve the undisciplined development of feeling about a research report's methodological adequacy as it is read for substantive content. At least forty procedures for systematic assessment of research quality have been developed since Monroe and Englehart's plea.[6] A procedure developed by Gephart and Bartos[7] and critiqued in an American Educational Research Association symposium is proposed as a guide for the needed research analysis. This procedure, called Research Profiling, examines five facets of the research process:

1. The strength of the logical argument inherent in the investigation;
2. The degree to which the units studied (subjects and samples) represent a specified population;
3. The degree to which the investigation controlled the phenomenon studied (the treatment) and factors which could provide rival explanations for the observed data;
4. The degree to which measurements used were valid, reliable, and objective; and
5. The appropriateness of the analysis procedures given the nature of the data in the investigation.

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[5]Walter S. Monroe and Max D. Englehart, The Scientific Study of Educational Problems. New York: The Macmillan Company, 1936.

[6]Copies of these have been collected by and are on file with the principal investigator of this project. A large number of these are identified in "A Review of Instruments Developed to be Used in the Evaluation of the Adequacy of Reported Research." Occasional Paper #2 Bloomington, Ind.: Phi Delta Kappa. 1969.

[7]William J. Gephart, "Profiling Educational Research." Occasional Paper #3. Bloomington, Ind.: Phi Delta Kappa, 1969.

The third problem of existing syntheses cited above was their substantive focus. Helen Robinson[8] has indicated that the field of reading has failed to distinguish between numerous factors involved. As a consequence a given definition of reading will concentrate as much on what must be done to teach or learn it as it does on the nature of reading itself.[9] To avoid repetition of this difficulty, the planning team for the Targeted R & D Program on Reading has called for three literature searches and syntheses on topics defined as follows:

1. THE READING PROCESS--the interrelated series of steps, operations, or activities of a linguistic, physiological, cognitive, perceptual, and psychological nature that come into play when the organism engages in reading behaviors defined as covert responses to verbal written language (Covert responses are indicated by overt performances which could not have occured without the covert responses to the written language. See Appendix B for additional discussion).
2. LANGUAGE DEVELOPMENT RELATED TO READING--the expansion of the individual's semantic, syntactic reservior as instruction in graphophonological translation of written language to sound and meaning is provided.
3. THE LEARNING TO READ PROCESS--the interrelated steps operations or activities through which the individual moves to achieve functional reading competence.

PRODUCTS OF THE LITERATURE SEARCHES

The three literature searches will develop summary statements which will:

1. Identify the partial and comprehensive models in each of the areas defined above;
2. Determine what is known and assumed about these models;
3. Present a synthesis of those models where commonality of elements and logic permit; and
4. Specify the research efforts that need to be undertaken to further develop each model remaining after the synthesis. This further development includes the specification of:

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[8]Helen M. Robinson, "The Major Aspects of Reading." In Reading: Seventy Five Years of Progress. H. Alan Robinson, (Ed.) Chicago: University of Chicago Press, 1966. pp. 22-3.

[9]Chall op cit. p. 13-14.

a. Studies which support (or reject) the combination of two or more partial models. Such combination might involve the synthesis of a number of partial models into one comprehensive model, the combination of several comprehensive models that are different only in vocabulary, or both. Such combinations will have been suggested on a logical basis in the previously mentioned literature search effort. These combinations must be tested empirically before further work is undertaken to document the logic of the combination.

b. Studies which test hypothetical elements of identified models. The literature search activity will classify all research conclusions in the literature into four categories: Conclusions generated via: (1) sound methodology and verified; (2) sound methodology and rejected; (3) questionable methodology; and (4) stated but not empirically tested. The latter two categories must be tested by sound empirical techniques before the model can be accepted as a representation of a process.

c. Studies which define and depict constructs in the models. Literature on reading proposes many constructs which on the surface have striking similarity; Gage[10] cites the following as an example: reading readiness, entry behaviors, and pre-existing cognitive set. Many take these terms as synonyms. Careful analysis indicates that there are common and uncommon elements to them. Their differences and similarities have not as yet been explored empirically, a task that must be completed if models are to be further developed.

d. Studies which fix "factor values" for the elements of a model and which determine their "calculus-of-operation." Operational prediction requires quantification of the constituent elements of a model and generation of formulas descriptive of the functioning of those elements.

e. Studies which establish the predictive capability of a model. If a predictive model has been generated its validity must be established by

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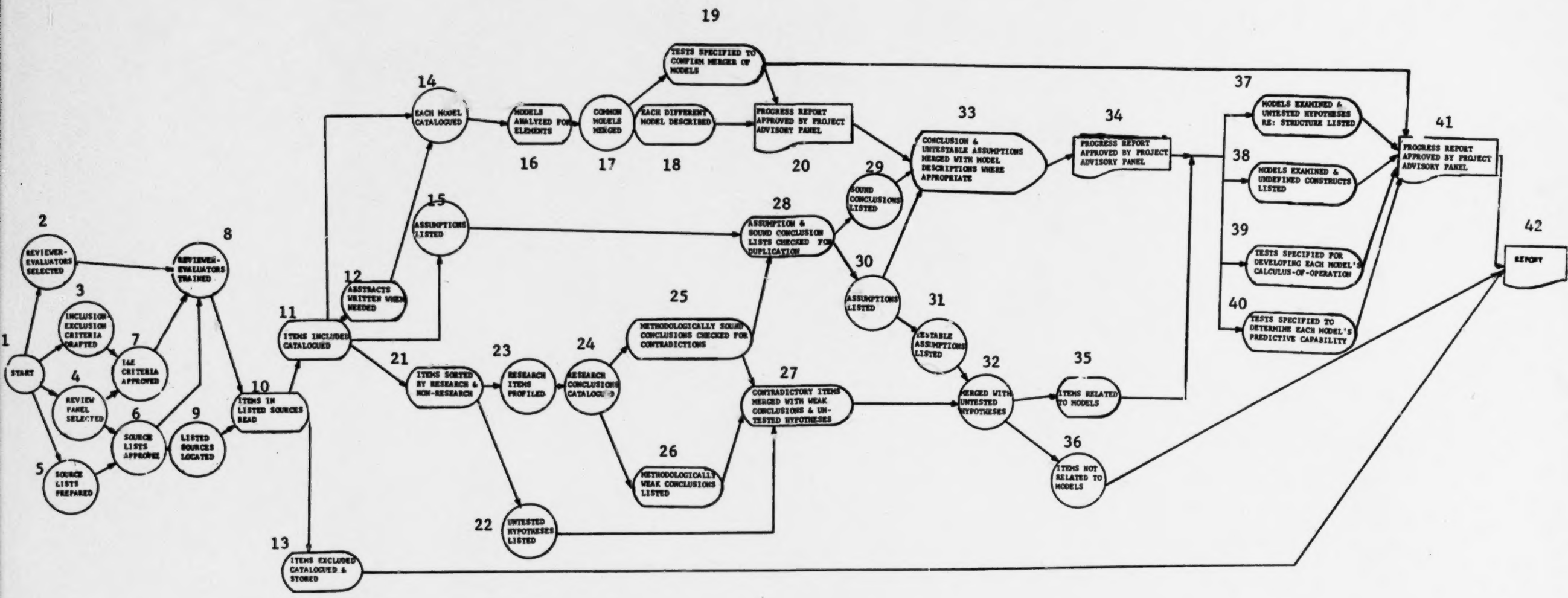
[10]N. L. Gage & W. R. Unruh, "Theoretical Formulations for Research on Teaching." Review of Educational Research 37:358-370; June 1967. p. 366.

comparison of its output with real data. That is, it should be possible to operate the model and produce output that agrees with observable output when the phenomenon itself is in process.

PROCEDURES PROPOSED FOR THE LITERATURE SEARCHES

A chart outlining the activities in the literature searches is shown in Figure 9. Each of the activities identified in that figure are commented on below. These comments are keyed to the numbers on the chart. In reading these comments it should be noted that they are not always numbered in the time sequence in which the work must progress. It should also be noted that work will be in progress on many of these activities at the same time.

1. Start.
2. Reviewer-Evaluators Selected--Several persons must be employed to do the work of reading and evaluating the separate items of related literature. It is suggested that these persons be recent doctoral graduates with a composite of specialties likely to be encountered in the literature (e.g.: perception, vision, reading, learning, etc.). It is assumed that the proposal through which project funds are secured will have named the project director, personnel for the advisory panel, and a research methodology specialist.
3. Inclusion-Exclusion Criteria Drafted--The project personnel need to prepare an initial statement of criteria for the inclusion or exclusion of separate pieces of literature in this synthesis activity. This statement is to be used as a working draft with the project review panel. These criteria will focus on the substantive content of articles to be included or excluded (e.g.: a literature search on the reading process should include works on perception, vision, mental processing, etc. and will exclude works dealing exclusively with teaching methods, instructional materials, etc.)
4. Review Panel Selected--Specialists from each of the disciplines likely to contribute information about models of the target phenomenon should be contracted with as an advisory/review panel for the project. Possible participantion should be arranged prior to submitting a proposal and the tentative advisory panel members and their qualifications listed with the proposal.



TRDPR Literature Search

W.J. Gephart

12-15-69

Figure 10.

5. Source Lists Prepared--The project staff should prepare a draft listing of the literature sources to be examined in the project. It is anticipated that such source lists will include publications, fields of study, institutions, and individuals that have focused on the topic central to the literature search.
6. Source Lists Approved--The Advisory Panel should check the draft listing of literature sources. Where possible they should add additional sources to ensure comprehensiveness of the literature search. Where the Advisory Panel is certain of the unproductiveness of a source, it should be deleted. The source list that is approved will provide the boundaries for the literature search in terms of published works and unpublished research reports and articles to be examined.
7. Inclusion and Exclusion Criteria Approved--The Advisory Panel should check the draft criteria for their clarity and comprehensiveness and make modifications where their expert judgement deems it warranted. This activity will produce a set of criteria on which to base the decision to include (or exclude) a specific document or article in the literature synthesis.
8. Reviewer-Evaluators Trained--The selected reviewer-evaluators must understand (1) the Inclusion-Exclusion Criteria, (2) the overall purpose of the search (see items 19 & 37-42), (3) the procedures to be employed in the search, (4) the nature of and format for abstracts on all processed literature items, (5) the research profiling approach to the evaluation of the methodological adequacy of completed research, (See Appendix I) and (6) resources available to them for resolving questions encountered in their work.
9. Listed Sources Located--After a literature source list has been approved, each item in it must be physically located. Complete copies of all relevant work should be obtained. If they cannot be obtained, arrangements must be made to work with them at their current location.
10. Items in Listed Sources Read--One or more of the reviewer-evaluators must read each document (report or article) from each listed source and examine it against the inclusion-exclusion criteria. A decision on each article should be made which places it in either an inclusion (See #11 below) exclusion (See #13 below) file. A notation should be made which justifies this decision for each article.
11. Items Included Catalogued--Each document which satisfies the inclusion criteria shall be catalogued by recording source, bibliographic information, and topics dealt with.

12. Abstracts Written When Needed--A brief abstract for all included items shall be prepared giving general description of the item and explicit listing of assumptions, hypotheses, conclusions, and models described.
13. Items Excluded Catalogued and Stored--Each document that fails to meet the inclusion criteria shall be catalogued by recording source, bibliographic information and reason for exclusion.
14. Each Model Catalogued--Every model discussed in the literature (accepted in #11 above) will be catalogued by recording a brief description of the model and its bibliographic source.
15. Assumptions Listed--A separate file will be kept which lists the assumptions made by an author or researcher. This listing will include a statement of the assumption and bibliographic information.
16. Models Analyzed for Elements--Each model will be analyzed to identify its constituent elements. This should include both structural and process elements.
17. Common Models Merged--When two or more separately referenced models consist of the same component elements, they are to be merged and a statement made giving the rationale for this merger.
18. Each Different Model Described--As complete a description as possible will be prepared for each model remaining on the lists after all mergers have been affected (activity 17).
19. Tests Specified to Confirm Merger of Models--The merger of two or more models will have been done on the basis of a logical analysis of their elements. This logic must be tested empirically in Phase II of the Program. Thus, as models are merged empirical tests which will confirm or disconfirm each merger must be designed. These items will comprise a part of the literature search final report as part of the recommended research program on models.
20. Progress Report Approved by Advisory Panel--The Advisory Panel will be asked at this point to check (1) the adequacy of the analysis of each identified model, (2) the logic of the merger of two or more models, (3) the comprehensiveness of the work to date, i.e., are there any models known to members of the Panel that have not been incorporated into the listings and synthesis to date. The Panel should also check on a sampling basis, those articles excluded (Activity 13) to determine the adequacy of the application of the exclusion criteria by the reviewer-evaluators.

21. Items Sorted by Research & Non-Research--As each document is read it is to be catalogued either as (1) a report of empirical research or (2) other writing on the topic (non-research). If the report poses and empirically tests a hypothesis or answers an empirical question it is to be accepted as research.
22. Untested Hypotheses Listed--All documents labeled non-research will be examined for untested hypotheses. These will be listed along with untested hypotheses presented in research documents. Along with the hypothesis, bibliographic information will be recorded.
23. Research Items Profiled--Each document labeled a research item in #21 will be analyzed for methodological characteristics and adequacy. This analysis will examine the inherent logic in the research design, the quality of sampling, measurement, and treatment techniques, and the adequacy of the statistical analysis employed (See Appendix I).
24. Research Conclusions Catalogued--A research conclusion in this context is a statement summarizing an answer to an empirical question or a statement about the truth or falsity of a specific hypothesis. Each conclusion in these articles will be listed along with a profile of the adequacy of the research methodology on which it is based. Common conclusions will be merged and the resultant conclusions listed under two rubrics, methodologically sound or unsound.
25. Methodologically Sound Conclusions Checked for Contradictions--The listing of conclusions based on sound research methodology must be examined for contradictions. Where two or more contradictory conclusions are identified, they must be considered as inconclusive and sorted from what is known about the phenomenon under study.
26. Methodologically Weak Conclusions Listed--All conclusions based on questionable research methods shall be listed as still to be tested hypotheses along with bibliographic references and the rationale for the placement in this category.
27. Contradictory Items Merged with Weak Conclusions and Untested Hypotheses--The conclusions listed in activities 25 and 26 and the untested hypotheses listed in activity 22 are to be accumulated and common items merged to form a list of untested hypotheses.
28. Assumptions & Sound Conclusion Lists Checked for Duplication--The listings from activities 15 and 25 are to be compared for duplication. Any items common to the two lists are to be deleted from the list of assumptions.

29. Sound Conclusions Listed--This listing constitutes the empirically substantiated body of knowledge about the phenomenon being studied.
30. Assumptions Listed--Two categories of assumptions exist in research, things beyond our ability to empirically confirm and things that can be but have not been confirmed to date. Any final list of assumptions should not include any of the second type if they have been empirically confirmed by other research efforts. The list of assumptions possible after activity 28 will exclude any such items.
31. Testable Assumptions Listed--Those assumptions in the listing produced in activity 30 which are subject to empirical tests shall be separately listed along with suggestions for the nature of those empirical tests.
32. Merged with Untested Hypotheses--The assumptions which are subject to empirical tests are comparable to untested hypotheses and should be merged with the list produced in activity 27.
33. Conclusions & Untestable Assumptions Merged with Model Descriptions Where Appropriate--This activity produces a synthesis of what is known and assumed for each separate model identified in the literature search. As such it is the most detailed statement about each model of the phenomenon being studied given the current state of the art.
34. Progress Report Approved by Project Advisory Panel--The synthesis of what is known and assumed with accepted model descriptions should be examined by the Panel for logic and comprehensiveness. If it appears possible to further merge either partial models into a comprehensive model or to merge comprehensive models, such mergers should be discussed with and approved by the Advisory Panel. The Panel should also check for details (facts or assumptions) that may have been deleted in the processing to this point.)
35. Items Related to Models--The listing of untested hypotheses should be culled for items that relate to one or more of the models approved in activity 34.
36. Items Not Related to Models--Those items remaining in the list of untested hypotheses after activity 35 should be catalogued along with bibliographic references, and suggestions for the nature of their empirical tests. These items become part of the literature search final report and are to be listed as needed research but not related to models and thus not implemented as part of the TRDPR.

37. Models Examined & Untested Hypotheses Regarding Structure Listed--Hypotheses about the structure of models approved in activity 34 should be listed by (a) examination of each model itself or (b) from the lists generated in activity 35. Where possible the details for testing a specific hypothesis should be specified and documented. These items comprise a part of the literature search final report and are research efforts to be undertaken as part of the TRDPR.
38. Models Examined & Undefined Constructs Listed--It is anticipated that hypothetical constructs will be involved in the models that reach this stage. Those constructs should be listed and research proposed which will empirically define them (i.e., attention, motivation, etc.) These items comprise a part of the literature search final report and are research efforts to be undertaken as part of the TRDPR.
39. Tests Specified for Developing Each Model's Calculus-of-Operation--It is anticipated that models which reach this stage will be verbal or verbal-pictorial representations of the phenomenon studied. In such a model the interrelationship of elements is suggested but not specified. Tests must be described which will quantify these elements (i.e., eye-movement, attention, meaning, etc.) and develop mathematical formulations for their interrelationships. These items comprise a part of the literature search final report and are research efforts to be undertaken as part of the TRDPR.
40. Tests Specified to Determine Each Model's Predictive Capability--A model is a representation of some thing or phenomenon. It displays the elements of the modeled phenomenon, the manner in which those elements interact, and the results of their interaction. When a good model is operated it should produce results that are produced by the phenomenon itself. Each model identified in the literature search and approved in activity 34 should be examined for this predictive capability. Tests of predictive capability must be specified for models that have reached a sufficient stage of development. These items comprise a part of the literature search final report and are research efforts to be undertaken as part of the TRDPR.
41. Progress Report Approved by Project Advisory Panel--This approval covers five categories of proposed research efforts: (1) Studies to confirm the merger of two or more models (activity 19); (2) Tests of hypotheses about the structure of identified models (activity 37); (3) Studies

designed to further define constructs in the models (activity 38); (4) Studies designed to facilitate quantification of the factors involved in the models and of their function (activity 39); and (5) Studies designed to test a model's predictive capability (activity 40). The Advisory Panel should examine the specific studies proposed for their logic and comprehensiveness and make appropriate suggestions for improvement.

42. Report--The final report shall include: (1) a description of each model identified and approved by the Advisory Panel along with documentation of its features as currently known and operationsl characteristics (activity 34 output); (2) Proposals for specific studies recommended for the further development of these models (activity 19, 37, 38, 39, 40 output); (3) A listing of the untested hypotheses which are unrelated to any model (activity 36 output); and (4) an annotated bibliography of those documents examined but rejected for this literature synthesis (activity 13 output).

In keeping with the details of the Convergence Technique as proposed by Carrese and Baker[11] the above procedures should be critiqued by specialists. The procedures outlined above have been examined and modified on the basis of accumulated critiques. Requests for Proposals will further this critique process by submitting the plan as the basis for the work to be done. Interested investigators will be invited to propose modification in this plan where they can make a logical case supporting the modifications. Through this process the soundest literature search and synthesis procedures will be employed.

The work described above will provide initial inputs to the information system for the Targeted R&D Program on Reading. This information system will undertake the responsibility for accumulation of subsequent knowledge about the phenomena involved, storage and retrieval of that knowledge, and periodic synthesis of what is known.

SUMMARY

Phase I of the Targeted Research and Development Program on reading calls for: the identification of extant models of

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[11]Louis Carrese and Carl Baker, "The Convergence Technique: A Method for the Planning and Programming of Research Efforts." Management Science, Vol. 13, No. 8, April 1967.

three phenomena, the process of reading, the process of learning to read, and language development related to reading; the analysis of those models to determine their structural and process elements; the synthesis of models which are composed of the same elements; the evaluation of completed research on these phenomena to determine what is known about them; and the specification of research efforts to be undertaken to further refine and develop the models. A procedure for this work is outlined which, when completed, will provide information on which to base the research on models to be conducted in Phase II.

CHAPTER VI

LITERATURE SEARCH AND SYNTHESES ON READING INSTRUCTIONAL PRACTICE AND ITS PRODUCTS (PHASE I ACTIVITY)

As indicated in Chapter II the Targeted R&D Program on Reading identifies two paths to a goal of functional reading competence, (1) the development of predictive models of the phenomena involved in reading and learning to read; and (2) adaptive experimentation with reading instruction. It is possible to reach the program goal through either path given success in the activities within it. Because it is impossible to quantify the probability or cost of success in either of these paths, they are recommended as concurrent activities in Phase II of the program. The model building path and activities prerequisite to it are discussed in Chapters III, V and IX. Adaptive experimental work on reading instruction is discussed in Chapter X. This chapter details literature search work prerequisite to that adaptive experimentation.

The second part of the Preresearch Phase of the Targeted R & D Program on Reading was described in the interim report to the U.S. Office of Education as:

> A search, analysis, evaluation and synthesis of literature and existing survey data on the level of reading achievement and the nature of the instructional effort. The product of this effort would be baseline data on:
>
> a. Level of reading skill development
> b. Instructional practice including:
> 1) time spent
> 2) procedures employed
> 3) materials used
> c. Amount and character of manpower and resources expended in reading instruction. (Appendix H.)

As indicated in the interim report, this effort will provide base line data for any effort to improve reading performance. For the Targeted R & D Program on Reading, a second purpose is served. Through the summary of what is known about

the nature and variety of reading instruction and about the products of that instruction, children's ability to read, program management decisions about the Adaptive Experimental Laboratories (AEL's) will be facilitated. This same information should be helpful to reading specialists within the AEL's as they seek ways of reducing the discrepancy between the objectives being sought through reading instruction and actual outcomes. A brief description of the AEL program is necessary background for the literature search described in this Chapter.

THE ADAPTIVE EXPERIMENTAL LABORATORIES

This part of the Targeted R & D Program on Reading is an adaptive manipulation of reading instruction designed to increase functional reading competence. This work will involve ongoing reading instruction programs augmented by reading and evaluation expertise. Each AEL will operate in a self-correcting strategy involving the following elements:

1. Each AEL will specify the reading behaviors to be accomplished through instruction.
2. The ongoing instructional program will be observed and records describing its structural nature and processes will be kept.
3. Measurement procedures will be employed to continually assess the achievement of the reading behaviors identified in #1 above.
4. The nature of the discrepancy between the desired objectives and the actual outcomes will be analyzed.
5. Where possible, observed discrepancies will be associated with elements of the instructional program record.
6. Based on the above analysis the instructional program will be modified to reduce the discrepancy. In some instances this modification may involve change of instructional procedures and materials, in others a reduction of the range of children involved, while still others may call for a modification in the objectives sought.
7. The modified instructional system will be operated. The AEL will cycle through the steps listed above until the discrepancy between the objectives and outcomes falls within the acceptable range set in the program goal.

The output of the AEL operation is instructional approaches, procedures and/or materials which are effective in increasing functional reading competence. It is expected that items within this output will be partial contributions to the program goal. This partial nature maybe in one of two senses. First, the item may be effective in use with only a subset of the target

population. Second, the item may be effective in generating only part of the behaviors involved in functional reading competence. A 2X2 table can be structured with these two conditions which indicates the possibility of four outputs of the AEL.

ADAPTIVE EXPERIMENTAL LABORATORY OUTPUT CHARACTERISTICS

Population with whom the item is effective	Behaviors Developed: Part of the Program Goal	Behaviors Developed: All of the Program Goal
Subset of Population	A	B
Total Population	C	D

Figure 11

Instructional approaches or materials classified into cell A would have been observed in an AEL to be effective in producing part of the desired behaviors with some subset of the population. Those in cell B would fully achieve the program goal with a specified subset of the population. Cell C is a classification of instructional items which are effective for developing part of the desired behaviors with the entire population. Cell D is of course the desired end point. When an AEL indicates accomplishments which can be classified in this cell, an approach is available for widespread confirmation tests. Any item classified into cells A, B, or C must be accompained by valid measuring procedures for identifying learners who belong to the population subset, for determining the accomplishment of the subset of behaviors, or both.

As indicated earlier, a number of AEL's are to be established, each of which is at the outset to have a different instructional approach. The decision to employ multiple approaches is based upon the failure of comparative studies to consistently identify one instructional approach as more effective than another.[1]

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[1]Guy Bond and Robert Dykstra, Coordinating Center for First Grade Reading Instruction Programs, University of Minnesota, 1967. (Final report USOE Project 5-0341)

The proposed literature search on the practice and products of reading instruction serves still another purpose in the Targeted R&D Program on Reading. Phase III of the program calls for the design and test of a reading instruction system that achieves the program goal. That effort involves the assembly and integration of known components (instructional materials and procedures) in ways that serve the desired function. The proposed literature search will identify items which may be used in this Phase III activity.

LITERATURE SEARCH ON READING INSTRUCTION PRACTICE AND PRODUCTS

Reading instruction practice is the focus of much discussion in the literature. These presentations display a array of approaches or methods, of materials and equipment, and of content. Unfortunately no definitive work exists that fully summarizes existing instructional practice. Chall[2] says, for example, "I have not studied content as thoroughly as method, and therefore cannot make specific recommendations on this aspect of reading instruction." The planning team believes that a systematic attempt to effectively modify instructional practice must be based upon what is known about all aspects of reading instruction practice. Thus, they have included in the Preresearch Phase of the program a comprehensive search of existing literature for information which defines practice.

The proposed search has three general directions which will result in reports which synthesize what is known about: (1) the nature (and variation) of reading instructional practice as it occurs in schools; (2) the results of that practice in terms of reading competence (but not in terms of cause and effect.); and (3) the nature and extent of teacher education for reading instruction. This effort has come of the same characteristics of the literature searches on models described in Chapter V. It will involve: the establishment of an advisory panel to give general direction, review, and evaluate the work as it progresses; a staff to collect, read, evaluate, catalogue, and synthesize that knowledge presented in the literature; and, an examination of available data relevant to the three products above.

The report on this literature search must at the outset attend to definitions of the terms in instructional practice as great variation exists. The term "method" is an example. Some articles use that term to refer to the overall nature of the instruction (meaning-emphasis method vs. code-emphasis method).

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[2]Jeanne Chall, Learning to Read: The Great Debate. New York: McGraw-Hill Book Company, 1967. p. 310.

Others use it in reference to a classroom organization (individualized method). Still others use it to refer to materials involved in the instruction (i/t/a method). To complicate the matter further the term "approach" is used interchangeably with "method" in some of these uses. The project staff must develop a set of definitions for these terms and use them consistently.

A second preparatory task for the proposed literature search is the development of description of a reading instruction system of the sort described by Hills.[3] Such a description will identify the entities and properties necessary to specify the "...order, regularity, interdependence, or relatedness."[4] which produces reading competence. This work requires the delineation of the structural units that make up a reading instructional system, the patterns of relationships among these structures, and the processes through which the structural units interact to produce the system output, functional reading competence.

Logically, the structural components must include at least two categories of individuals, the learner and the instructor, resources such as time, knowledge, materials, and equipment, and the content, that is what is taught and learned. The process units involved include the activities through which the learners, teachers, and resources interact, and the independent behaviors of the learners, and teachers. The first task of the literature search project is to determine what variation in these components is known to exist in reading instruction practice. It is hoped that the report on this aspect of the search will provide two kinds of information about this variation. First, what different forms exist? And second, what is the frequency of occurence of each variation in practice? Information from this literature search will provide a basis for program decisions about the establishment and continued operation of AEL's.

The second product of this literature search is part of the information needed to specify the extent of our "reading problem." It will delineate the current output of the national reading instructional system. That information must later be combined with the level of reading competence sought as the goal of the Targeted R&D Program to make possible the specification of the extent of the existing reading problem.

The search for information on what is now being accomplished by reading instruction is constrained by existing measurement procedures. The project staff must identify surveys that have measured reading achievement, ability, or

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[3]R. Jean Hills, "The Concept of System." Eugene, Oregon: Center for the Advanced Study of Educational Administration, 1967. (ERIC Document Number ED 014 786)

[4]Ibid. p. 2.

competence, evaluate the methodology employed in those studies, and synthesize the internally valid generalizable findings. In some cases this review staff may find it of value to reexamine existing data to complete this task.

Where possible reading achievement for subsets of the total population of interest (individuals at or under age 10 and not in permanent care institutions) is to be delineated. Such breakdowns must be accompained by quantitative descriptions of the population subsets on relevant paramaters.

The third and final product of the proposed instructional practice literature search concentrates on teacher training. It is in effect a search for what is known about a different but related system. It asks for information which can be used to explain how the variation in instructors came to be in the system described above. It should encompass reports of research and theoretical papers on the preparation of reading instructors, examination of courses of study at major institutions, and a survey of certification requirements.

The final report for the literature searches should present where possible the relationships between the methods of reading instruction and reading achievement. In the absence of empirical evidence regarding these relationships the report should make estimates on a logical basis and present the reasoning used as the basis for these estimates. This report must also present designs for studies to be conducted as part of Phase II through which these estimates can be confirmed or corrected. The same procedures are requested regarding relationships between teacher education and methods used for instruction and teacher education and reading achievement.

SUMMARY

The Targeted R&D Development Program on Reading proposes a literature search and synthesis prior to the operation of a program of adaptive experimentation with reading instruction programs. Through that literature search existing knowledge will be catalogued to describe:

1. The nature and variation in reading instruction practice including
   a. Teacher behaviors
   b. Learner behaviors
   c. Materials and equipment employed
   d. Time and resources expended directly in instruction and indirectly in supervision.
2. The level of reading competence attained
   a. On a nationwide basis

b. By categories characteristics of
   1) the learner (sex, age, race, physiological factors, I.Q., etc.)
   2) the learner's environment (socioeconomic level, geographic areas, language spoken in the home, etc.)

3. The nature of teacher education for reading instruction.

In addition recommendations will be made which detail the needed studies and surveys for filling gaps in available information.

CHAPTER VII

PLANNING AND MANAGEMENT CONSIDERATIONS PRIOR TO ENTERING PHASE II OF THE TARGETED R&D PROGRAM ON READING

Through the application of the Convergence Technique[1] a multiphased research and development plan has been developed to achieve a goal of functional reading competence on the part of all individuals who reach age 10 and are not in permanent care institutions. The work thus far has employed only the planning component of the Convergence Technique. The individuals involved in this activity have recommended to the U. S. Office of Education that the program be implemented and that procedures specified in descriptions of the Convergence Technique by Louis Carrese be followed in conducting the program.

The first phase of the Targeted R&D Program on Reading calls for three preresearch activities. A literature search and syntheses on models of reading, learning to read and language development related to reading is the first of these activities. The second is also a literature search, this time focused on the nature of reading instruction practice and the outcomes of that practice. The third project is designed as the development of rationale and specifications for developing a criterion instrument for the Targeted R&D Program on Reading.

In making the recommendations listed above, the planning team argued that the three activities proposed as Phase I should be undertaken immediately by the Office of Education. This assertion was based on the recognition of a new national emphasis on the improvement of reading competence. The planning team argues that any effort to improve reading must be based on what is known about the phenomena basic to reading and

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[1]Louis M. Carrese and Carl G. Baker, "The Convergence Technique: A Method for the Planning and Programming of Research Efforts," Management Science 13:420-438; April 1967.

the practice of reading instruction, and be guided by an objective rooted in reading tasks which must be accomplished by participants in our culture.

Work has been initiated within the National Center for Educational Research and Development which indicates the acceptance of the importance of these three recommended projects. At this writing, staff of the National Center are involved in the preparation of Requests for Proposals (RFP's) through which those three activities will be carried out. The general nature of those efforts has been discussed in earlier sections of this report. This chapter assumes that those activities will be successfully completed and concentrates on details and procedures which need to be attended to prior to the implementation of Phases II-V of the Targeted R&D Program on Reading. Five items make up the necessary procedures:

1. Subjecting the overall program plan to critique on the part of professionals in the field.
2. The establishment of the program within the organization of the U. S. Office of Education.
3. The development of specifications for a program information system.
4. The specification of a planning session for the model development work included in Phase II.
5. The development of specifications for the Adaptive Experimental Laboratory Program in Phase II.

The substantive content for items 4 and 5 are to be provided through literature searches described above. Thus, the discussion of them below will deal with procedures needed for implementation. This same focus is carried through the other items in this list.

CRITIQUE OF THE PROGRAM PLAN

As guidance for setting up a Convergence Technique planning team, Carrese makes the following recommendation, "The planning team should not exceed five members whenever practicable."[2] The formulation of the plans and the development of related activities involve continuous and exhaustive interaction between members of the planning team. Since agreement must be reached both on the logic of the program plan and the work to be conducted within it, larger groups are not productive.

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[2]Ibid. p. B-424

To maintain this small size, a planning team is composed of individuals representative of different disciplines. When such a team is composed it is possible to identify an individual who has an inadequate perception of the knowledge in his discipline. Despite precautions taken in the identification and selection of planning team members this possibility must be considered before the program plan is implemented. The Convergence Technique procedure calling for critiques of a developed plan are the means whereby such an error is countered.

In bio-medical applications of the Convergence Technique critiques of every proposed program plan have been obtained before the plan is implemented. The critiques typically result in some slight modification of the activities proposed within a phase. Apparently the procedures involved in the Convergence Technique planning effort are such that a logical plan evolves which is generally acceptable to the many specialists in the related fields.

The importance of obtaining systematic critiques of the program plan proposed for the Targeted R&D Program on Reading cannot be underestimated. The planning team consisted of a specialist in educational research methodology, in reading, systems analysis, psycholinguistics, and a representative of the major funding agency, the U. S. Office of Education. Initially plans called for the inclusion of an individual with background in the area of neuro-physiology. It was impossible to obtain this area of expertise within the time constraints of this project. Thus, the plan was developed without continuous input from that speciality. Instead consultants were involved for brief periods.

The planning team proposes that the U. S. Office of Education contract with individuals from a variety of disciplines for a critique of the overall program plan. Areas of speciality to be represented by the critiquers should include but not be limited to the following: (1) researchers on the process of reading; (2) specialists in reading curriculum development; (3) psycholinguists; (4) perceptual psychologists; (5) neuro-physiologists; (6) measurement specialist; (7) instructional materials developers; and (8) systems analysts. Several highly reputable persons should be identified in each of these areas. Each of them should be provided with a copy of the final report of the planning effort. They should be briefed regarding the nature of the Convergence Technique and provided the opportunity to discuss the technique and the program goal with representatives of the program management offices in the U. S. Office of Education. A statement should be prepared describing the nature and the use that will be made of the expected critiques. This statement should call for the separation within a written critique of comments regarding the content of the proposed program, the logic of that program, and recommendations about

its further management. Where possible the critiquer should clearly note the strengths and weaknesses of the program. Further, if it is possible the individual preparing the critique should differentiate between those which are made on the basis of empirical evidence. Each individual doing a critique should be encouraged to put in writing any modification he sees necessary to compensate for weaknesses in the program plan. He should also be encouraged to suggest specific projects which would contribute to any phase of the program.

The reports from the critiquers should be accumulated by program management personnel in the National Center for Research and Development (NCERD) within the U.S. Office of Education. Recommendations for major revisions in the proposed plan which are based on sound logic and empirical evidence should be culled from the collected critiques and presented to members of the planning team which prepared the proposed program or another similar group. That group along with the program management personnel should be assigned the responsibility of incorporating the changes which have both a sufficient data base and convincing logic.

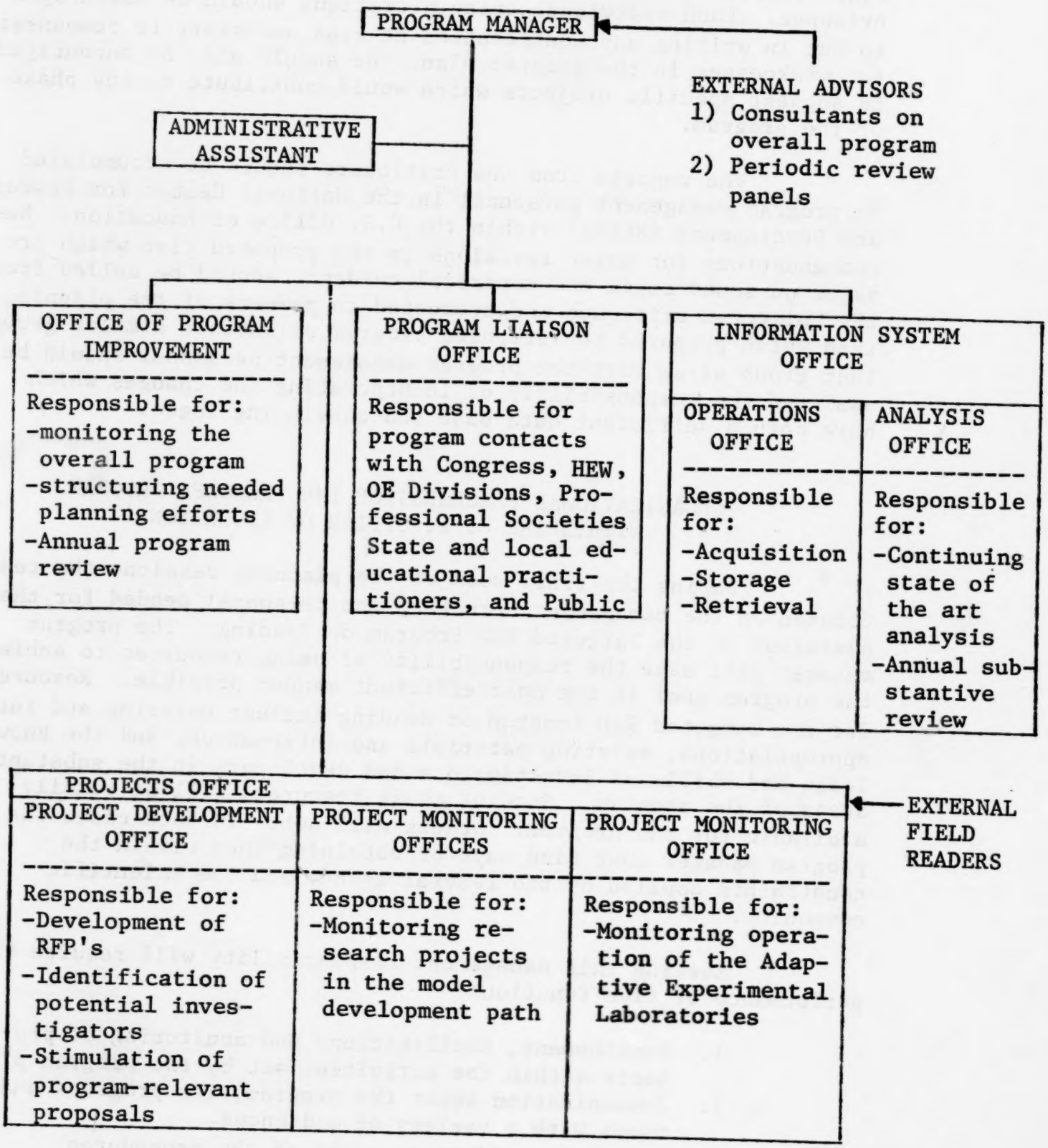
ORGANIZATIONAL PLACEMENT OF THE PROPOSED PROGRAM WITHIN THE U. S. OFFICE OF EDUCATION

During the final week of the planning sessions the team focused on the management structure and personnel needed for the operation of the Targeted R&D Program on Reading. The program manager will have the responsibility of using resources to achieve the program goal in the most efficient manner possible. Resources for the Targeted R&D Program on Reading include existing and future appropriations, existing materials and information, and the knowledge and skills of investigators and developers in the substantive areas of the program. Some of these resources will be readily avaliable for the program. Others will not. In such cases the program manager must find ways of obtaining them within the constraints applied by the federal agency and the scientific community.

Meeting this management responsibility will require the performance of five functions:

1. Development, facilitation, and monitoring of projects within the activities set by the program plan.
2. Communication about the program, its progress and needs with a variety of audiences.
3. Evaluation and improvement of the procedures used in the operation of the program.
4. Periodic synthesis of what is known about the substantive content on which the program concentrates.
5. Communication about substantive developments resulting from program efforts or from efforts outside the program.

The diagram below summarizes the planning teams discussion of program management.



The Projects Office identified in the diagram is recommended to fulfill the first of these functions. A large number of projects are to be conducted in the course of the Targeted R&D Program on Reading. Some of these will be described in great detail by the planning sessions conducted as the program progresses. Such is the case when the program planners and managers can be precise about the nature of needed information. There are other points in the program plan where this precision is not possible. In those cases only a general problem area will be defined as the basis for requests for proposals. Development of the RFPs for either specific projects or projects in general problem areas is the first responsibility of one unit in the Projects Office. Associated with that responsibility is the review and selection of the proposals actually submitted.

The Projects Office has a monitoring responsibility with funded projects. That responsibility is designed into the structure in the two project monitoring offices. The first of these should have responsibility for the research efforts related to the development and use of models while the second is assigned responsibility for the Adaptive Experimental Laboratories. The planning team estimated that fifty to sixty-five projects would be necessary in the research on models. Thus, a minimum of two research monitors should be employed in that project monitoring office. The AEL monitoring office will have six projects and should require only one staff member. The three persons in these project monitoring offices should know the research process and the field of reading, and, they should have demonstrated capability in attending to problems encountered in the management of research efforts. They should be familiar with the operations of the Office of Education and capable of facilitating the work of the projects to which they are assigned.

The planning team recommended that the work of the four persons described for project development and monitoring be supervised by a projects officer. This person should be a capable research administrator who can perform any of the duties described for this office. He should also be capable of working with and using the talents of external field readers either individually or in groups.

The Information Systems Office serves two of the functions listed above. The first of these, labeled as an Operations Office, has responsibility for the acquisition, storage, and retrieval of information generated by projects within the program and by independent efforts. The second, labeled as an Analysis Office, has responsibility for continued analysis of the state of our knowledge about reading and related phenomena and the preparation of an annual review of this knowledge with respect to the program objectives. The first of these requires a composite of skills similar to those possessed in the ERIC Clearinghouses. The second focus requires ability to evaluate the methodological adequacy of completed

research, the ability to conceptualize the nature of the field, and to synthesize separate efforts into a comprehensible system.

The planning team assumed that the program information system would be operated on a contract outside the U.S. Office of Education. Given that assumption the operations and analysis offices and a coordinator in the Information System Office would be at that contract site. The incumbent in the Information System Office would frequently have to travel to Washington, D.C. unless, of course, that office is located in Washington.

The Office of Program Improvement was structured for the express purposes of program evaluation and planning. The Convergence Technique assumes that changes are likely to occur in the program plan as new information is generated. Attending to the identification and integration of those changes is the first responsibility of the Office of Program Improvement. This will involve overall program monitoring and arranging for phase planning efforts when needed. The annual program review listed under this office concentrates on the logistics and processes of the program. In that respect it supplements the annual substantive review called for from the Information System Office.

The final unit in the proposed structure is a Program Liaison Office. Continued contacts must be made with a variety of individuals and agencies to assure clear understanding of the program's progress, plans, and needs. Included in the agencies to be contacted are Congress, the Bureau of the Budget, the Secretary's Office of the Deaprtment of Health, Education and Welfare, other divisions within HEW which operate programs through which projects related to the program might be undertaken. The participation of practitioners and researchers is vital both in the conduct of projects and as contributors to the anticipated planning decisions. Because of this, liaison between the program management and professional societies and individual scientists must be a part of this office's responsibility.

Four additonal items are presented in the planning team's program management recommendations. First, the work of these four offices described above should be supervised by an individual who knows the research process, who is an accomplished research manager, who knows systems analysis procedures, and who is capable of working with specialists in research and reading in the field as the program plan is modified and/or extended. Those field specialists constitute another element in program management. The management of the program calls for the use of expertise in the field in two ways, as sources of advice on the overall program and as field readers in the decisions about specific projects. This program must have funds for the continued use of consultants for specific program decisions and for periodic review. The individuals involved must have displayed continued

competence in the areas on which advice is sought and their judgements must be acceptable to the majority of their peers. An administrative assistant to the program manager is the final element in the planning team's recommendation. The number of contacts the program manager will have with personnel within and outside the program along with his writing, supervision, coordination and meeting responsibilities are such that assistance is warranted. This assistant should assist in all aspects of the program as a potential substitute or replacement for the program manager. Thus, he should have at least the potential for developing the same skills and knowledge as the program manager.

Towards the end of the planning session the planning team attempted to make cost and time estimates for the work proposed. Figure 12 shows those estimates in terms of the number of man years required for the work. The minimum and maximum amount of time expected for the accomplishment of each of the identified activities is presented in Figure 12. The amounts in these figures are presented here to provide a basis for the planning team's recommendations regarding the placement of the Program within the organizational structure of the U.S. Office of Education. The reasoning behind each of these figures is presented in Appendix G. Figure 13 shows an estimated total of 5,635 man-years for the program. This does not include an estimated 220 man-years for program administration. It is anticipated that 669 man-years will be supported by USOE funds while the remainder of the estimated effort should come from other federal agencies, educational industries, regional laboratories, private foundations, universities and public schools.

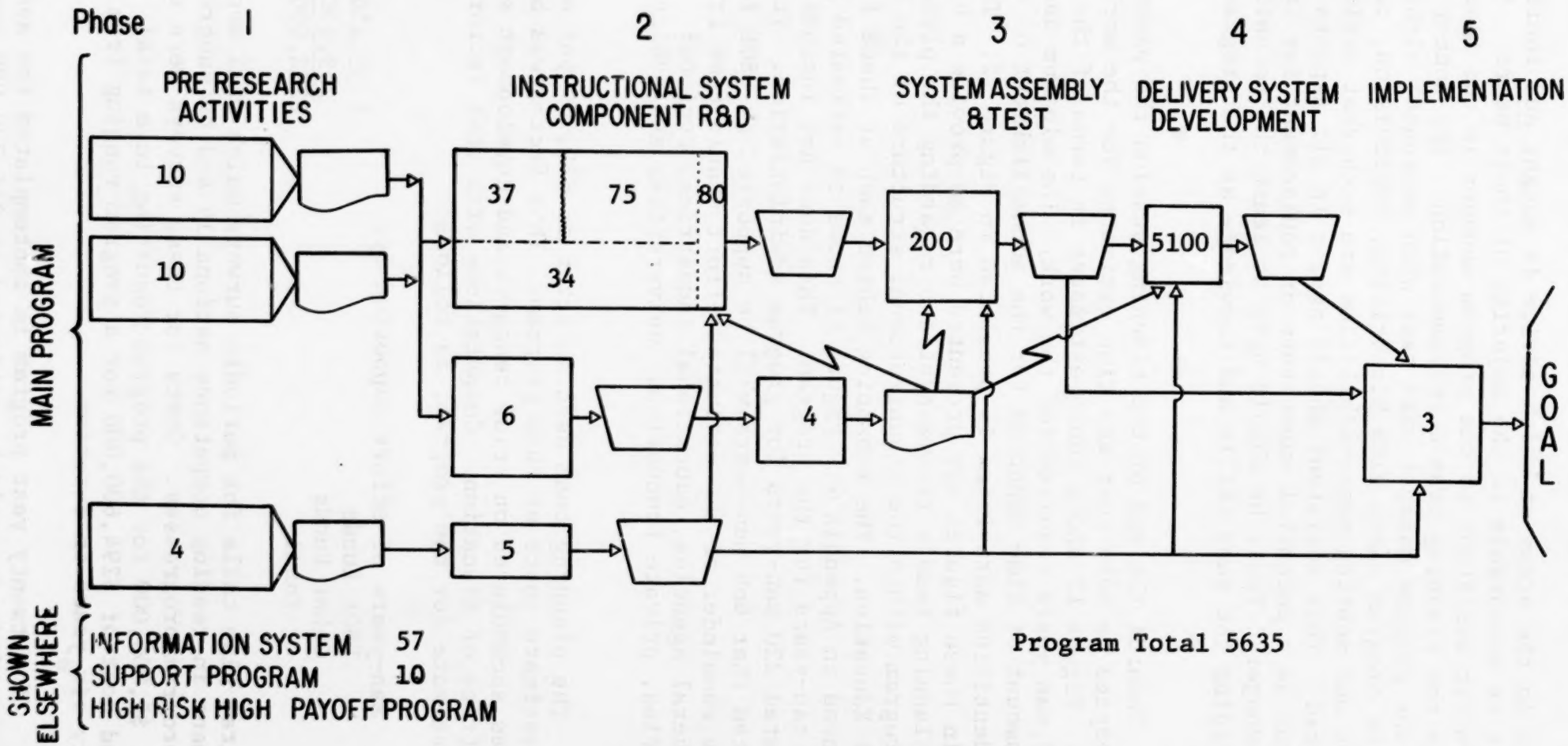
The planning team used a factor of $50,000 per man-year to estimate costs of this program. This factor was based on figures accumulated on prior research and development efforts in the Office of Education. Computations with that factor give a cost estimate for the program, as follows:

Man-years of effort supported by:	
USOE funds	$ 33,450,000
Other funds	259,150,000
Total	$292,600,000

The program plan calls for periodic surveys which will monitor achievement in reading competence nationally and by subgroups as the program progresses. Costs for these surveys were estimated at $2,000,000 for the program resulting in a total estimated cost of $294,600,000 for a program ranging from thirteen to thirty-six years in duration.

If a twenty year program is contemplated the average expenditure of funds would be estimated at $14,730,000 annually.

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR



ESTIMATED PROGRAM MAN-YEARS

Figure 12

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR

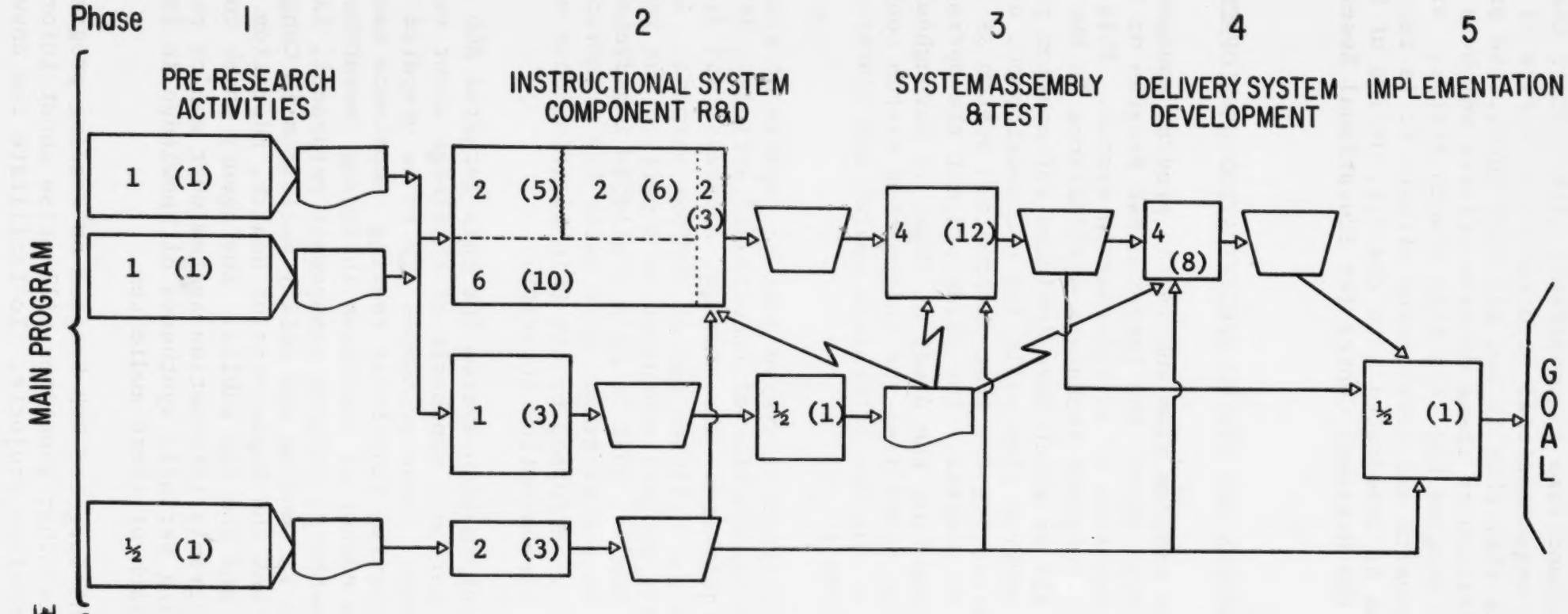


Figure 13

This level of expenditure is comparable with that of the Branches in the existing organizational structure U.S. Office of Education. Despite the fact that this is not all USOE money, the program requires coordination of these diverse efforts which is not possible if the program has less than branch status. Since the program is a research and development effort, it is recommended that the program be integrated into the U.S. Office of Education a· a Branch in the National Center for Educational Research and Development.

INFORMATION SYSTEM SPECIFICATION DEVELOPMENT

In the program plan and in the program management structure presented above, the Targeted R&D Program on Reading calls for the operation of an information system. This recommendation follows Convergence Technique applications in the biomedical field, all of which have included information processing elements. The program plan calls for the development of specifications and contracting for that information system as Phase I activities are in process. The plans project the operation of the information system from the start of Phase II throughout the program. In this scheduling the information system continues the effort started by the two literature search and synthesis efforts conducted in Phase I.

The information system must be capable of storage, retrieval and dissemination of reports and articles, data, and materials and equipment. The storage, retrieval and dissemination of reports and articles has an obvious purpose. Accomplishments made by any project conducted as a part of the Targeted R&D Program on Reading must be made available immediately to all other projects in the program. This calls for a service similar to that currently performed by the ERIC Clearinghouse on Reading plus a focused dissemination activity.

The information system for this Targeted R&D program must undertake periodic synthesis of knowledge about reading and related phenomena. These syntheses are to be prepared so that progress in achieving functional reading competence can be displayed for a number of audiences including researchers and project staff members, program management personnel, individuals who participate in funding and policy decisions in Congress, Bureau of the Budget, and the Department of Health, Education and Welfare, practitioners, and the lay public. Any agency which contracts to provide the program's information system must employ persons capable of making periodic syntheses of knowledge in formats acceptable to each of these audiences.

As the Targeted R&D Program on Reading progresses it is anticipated that questions will arise about information generated in previous projects. To facilitate the answering

of these questions the Program's information system must provide for storage and retrieval of data generated in the separate projects in the program. If this is done it will be possible to either reanalyze or perform additional analysis of those data in light of either new techniques or new information.

The final storage and retrieval capability concentrates on instructional materials and equipment. To facilitate those elements in the program plan which involve improvement of instruction, the information system must be able to provide examples of all the available and relevant instructional materials and equipment. To do so the information system must acquire copies of such items, catalogue them, develop brief descriptions of them which state the nature of the item, its purpose, and prerequisites. The information system must be capable of identifying those items in the collection which are relevant to a specific instructional task.

The outputs of the information system are implied in the section above. It must be able to find and provide items related to a specific request from a program project staff or from the program management. Concurrent with this request response, the information system must disseminate findings as they become available to individuals involved in the program. Lag time for this dissemination cannot be less than one week. Finally, the information system must prepare periodic state of the art presentations for use both within and outside the program.

The ERIC Clearinghouse on Reading was mentioned above. That agency along with Phi Delta Kappa's School Research Information Service, the Science Information Exchange, DATRIX, and others were mentioned in the planning team's discussion of the program information system. None of these agencies are currently capable of operating as the TRDPR information system. They currently are geared to collect reports and documents, store them, and retrieve them on demand. They all lack the focused dissemination capability described above, the capability to store and retrieve data, instructional materials, and equipment. They also lack the personnel which will be required to conduct the systematic evaluation of newly acquired research reports and to prepare the periodic program review and state of the art papers needed. The discussion of these agencies by the planning team should not be interpreted as an exclusion of other agencies which might like to bid on the Program's information system.

PLANNING THE MODEL DEVELOPMENT RESEARCH OF PHASE II

The Targeted R&D Program on Reading as proposed in this report is explicit and hopefully precise about the work to be done in Phase I. It recommends three areas of activity: (1) a literature search to determine what models of the reading, learning

to read, and language development processes exist (and what is known about these models); (2) a literature and existing survey analysis to determine the nature and results of reading instruction; and (3) the specification of a rationale for the criterion measuring instrument to be used in the program. The program plan not only explicates these areas of work it recommends procedures for carrying them out.

The program plan for Phase II is less specific than for Phase I. It is specific in calling for four areas of work: (1) the development and use of models in the design of prototype instructional system components; (2) adaptive experimentation with ongoing reading instruction; (3) independent confirmation of the effectiveness of any instructional items developed in (1) or (2); and (4) the development of a valid measure of functional reading competence (See Figure 14).

It is impossible to be more specific about the Phase II work at this point in time as its nature is dependent upon the Phase I products. No planning team can state that hypothesis X must be tested until hypothesix X is identified as a component of an acceptable model of one of the relevant processes (reading, learning to read, or language development related to reading). It was possible during the planning session to determine that a large number of models of the reading process exist. The planning team did not have the time necessary to determine the structural and process elements of each of these models, to combine those which have the same components, and to identify what is and is not known about each of the resulting modesl. This task was set as Phase I and designed to produce a report that identifies research needed in the following five categories:

1. Studies which support or reject the combination of two or more models. (For example in Phase I model X and model Y are analyzed as having the same components and thus are combined as one model. Can this combination be supported empirically? Also in Phase I partial models x, y, and z seem logically to fit together. Can this be borne out empirically?)
2. Studies which test specific hypothetical elements of an identified model. (For example, the Goodman model proposes a sampling of cues from the visual stimuli on the page. Can this be substantiated empirically?)
3. Studies which empirically define constructs used in a model. (For example, the definition of reading behavior developed in this project uses the term "covert behaviors." What can be established as the empirical referents for this term?)
4. Studies which develop the calculus-of-operation of a model. (For example, it is proposed that reading behaviors differ depending on the difficulty of

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PHASE 2--SUBOBJECTIVES & CRITERIA

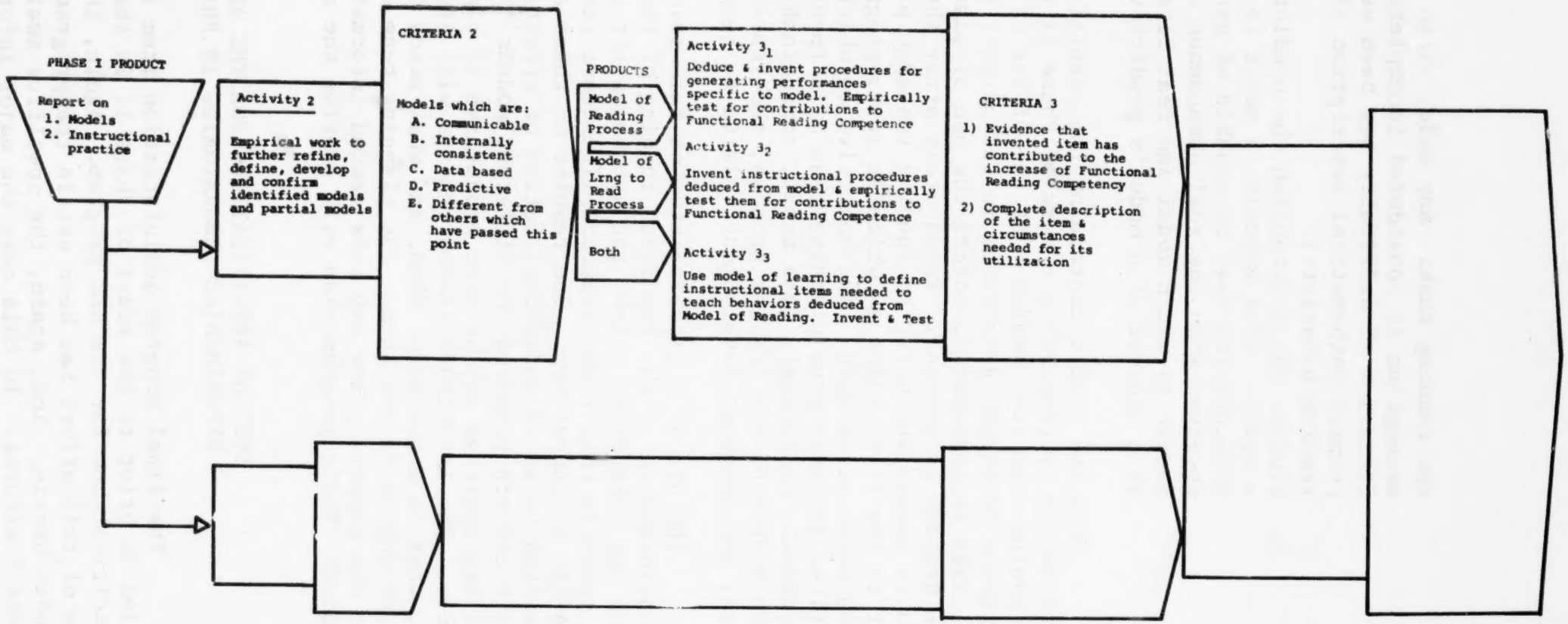
PHASE I PRODUCT
Report on
1. Models
2. Instructional practice
Activity 2
Empirical work to further refine, define, develop and confirm identified models and partial models
CRITERIA 2
Models which are:
A. Communicable
B. Internally consistent
C. Data based
D. Predictive
E. Different from others which have passed this point
PRODUCTS
Model of Reading Process
Model of Lrng to Read Process
Both
Activity 3₁
Deduce & invent procedures for generating performances specific to model. Empirically test for contributions to Functional Reading Competence
Activity 3₂
Invent instructional procedures deduced from model & empirically test them for contributions to Functional Reading Competence
Activity 3₃
Use model of learning to define instructional items needed to teach behaviors deduced from Model of Reading. Invent & Test
CRITERIA 3
1) Evidence that invented item has contributed to the increase of Functional Reading Competency
2) Complete description of the item & circumstances needed for its utilization

Figure 14.

the reading task. Any model which includes this assumption is considered incomplete until the quantification of difficulty has been established and permits mathematical description of the appropriate reading behavior.)

5. Studies which establish the predictive capability of a model. (For example, a model to be a valid representation must be capable of generating output observed when the real phenomenon occurs. The degree to which model and real life output agree is a measure of a model's predictiveness.)

Once the report containing the identified models and studies needed is prepared the work of Phase II can be detailed. The planning team recommended that the Office of Education use Convergence Technique procedures in the pursuit of the program plan. This recommendation covers the use of planning teams as the program progresses. Immediately after the literature search on models and prior to funding research proposed in that report is the first point at which an intra-program planning session ought to be held. The objective on which the work of this first intra-program planning team will focus is the creation of internally consistent, data based, communicable, and predictive models of the reading process, the learning to read process, and language development related to reading.

The use of a planning team at this point is recommended as an alternative to the immediate funding of the studies identified in the literature search and syntheses for two reasons. First, it is possible that three separate literature search efforts on models may be undertaken. The results of these efforts need to be synthesized to avoid undue duplication of effort. Second, the research efforts proposed for different models identified in the literature searches may be more productive if placed in a specific sequence. The literature search reports will indicate models exist, what is known about them, and what needs to be known to full develop or refute them. The planning team on models must answer the question, how can this needed information best be generated? Their program plan will provide the answer.

SETTING SPECIFICATIONS FOR THE ADAPTIVE EXPERIMENTAL LABORATORIES IN PHASE II

The final program administration item that must be attended to prior to the start of Phase II is the development of specifications for the AEL program. Again, the general nature of this effort has been set in the program plans recommended herein. And, again, the specifics await the completion of Phase I efforts. In this case the major informational input is the literature search and synthesis on instructional practices and products. The planning team recommended that six AEL's be

established in a manner which achieved a balance among the most generally used (and effective) reading instructional approaches and the population sub-sets most commonly encountered. (Examples of these approaches are presented in Chapter 10.) The literature search on instructional practice and its results are designed to identify existing reading instruction approaches, to detail their components, to summarize data on their frequency of use and effectiveness. These data will play a major role in specifying the variables to be encompassed in the selection of ongoing reading instructional programs as a basis for the Program's Adaptive Experimental Laboratories. This selection and the setting of operational boundaries is structured into the program as the first activity in the AEL line in Phase II (See Figure 13.). Through this activity the instructional approaches to be used will be selected, the operational procedures to be followed in the AEL's will be specified, proposals for operation of an AEL will be solicited and evaluated, and recommendations will be made to the Office of Education indicating the most productive set of proposals to fund.

SUMMARY

The planning and management considerations which must be attended to prior to the implementation of Phases II through V of the Targeted R&D Program on reading include: (1) the solicitation of critiques on the overall program; (2) establishment of the program within the organizational structure of the U.S. Office of Education; (3) the establishemnt of an information system for the Program; (4) organizating and conducting a planning session to pattern and sequence the model refinement and development research; and (5) setting specifications for the Adaptive Experimental Laboratory program. Each of these elements is vital to the functioning of the Targeted R&D Program on Reading. The absence of any one of them would severely limit its effectiveness.

CHAPTER VIII

MODEL REFINEMENT AND DEVELOPMENT RESEARCH AND PROTOTYPE INSTRUCTIONAL MATERIALS INVENTION (PHASE II ACTIVITY)

The activity to be described below is a part of Phase II in the Targeted R&D Program on Reading. As such there are some antecedent activities that the reader should assume to be completed. Those activities will have produced:

1. A description of the models (of the reading process, the learning to read process, and language development related to reading) that are currently in the literature;
2. An analysis of those models which delineates their structural elements, the patterning of those elements, and the processes through which they interact;
3. A summary of the facts and assumptions related to each of these models;
4. A listing of untested hypotheses about the structure and substance of each model;
5. A listing and description of studies that need to be undertaken to further develop and refine each model;
6. Descriptions of the instructional practices now used to teach reading and the product of those practices; and,
7. A delineation of the reading tasks to be accomplished through the work of this program.

Along with the activity to be described below, Phase II of the Targeted R&D Program will include two other lines of work. The first of these is an instrument development effort which has its subgoal the creation of valid and reliable procedures for measuring the performance of the identified reading tasks (See Chapter IV). The second activity involves the operation of a number of Adaptive Experimental Laboratories (AEL's) in which existing reading instruction approaches are systematically modified until they are effective in achieving all or part of the program

goal (See Chapter X). The reader should understand that the model development and instructional system component invention activities described in this chapter and the AEL's are alternative ways of achieving the same end, the production of effective components for a functional-reading-competence instructional system. He should further understand that a program information system will be in operation which will assure the transfer of information about accomplishments made in the model development activities to workers in the AEL's and vice versa.

This chapter will describe the nature of the products to be developed in either the AEL or modeling lines of the program. To do so it will discuss the concept of a "functional reading competence instructional system;" the concept of "model;" the source of models for this work; categories of the research and development efforts needed to be undertaken to further develop identified models; and, design methodology to be applied in the invention of instructional system components.

COMPONENTS FOR AN INSTRUCTIONAL SYSTEM: THE PHASE II GOAL

The Targeted R&D Program on Reading is in part a plan for developing an effective instructional system for all children who reach age ten (excepting those pathological cases in permanent care institutions). That instructional system will assure a level of functional reading competence which will enable the target population, through continued schooling, to become competent adult readers in our culture. Functional reading competence in this context is the ability to perform a set of reading tasks selected and abstracted from the array of reading tasks encountered in adult life (See Chapter IV). The tasks to be included will be selected after an examination of the economic, personal, social, and political ramifications of various possible subsets for their optimal benefit to the individual and society.

The meaning of the phrase "an instructional system" as conceived by the planning team could be displayed either by reference to existing examples or by using the abstract concept of system as presented by R. Jean Hills.[1] There is a problem in the use of existing examples. Doing so may apply some structural constraints to thinking that could limit the consideration of alternatives. The planning team emphasized that this programatic effort must be free to take any economically feasible direction. This is, <u>if</u> investigations in the Targeted R&D Program on Reading

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[1]R. Jean Hills, "The Concept of System" Eugene, Oregon: Center for the Advanced Study of Educational Administration, 1967. (ERIC Document Number ED 014 786).

should indicate that accomplishment of the program goal requires a specified interaction of children, their parents, and machines, the development and implementation of such an "instructional system" ought not to be hampered by the simple existence of traditional components of system such as the teacher and the school.

Hills indicates that many people conceive the referent of the term "system" as some physical entity or entities. He asserts that such an interpretation is incorrect and suggests instead "...that the referent of the concept ("system") is simple order, regularity, interdependence or relatedness."[2] Hills' statement cannot be taken to mean that objects are not involved. Order, regularity, interdependence or relatedness may or may not involve objects. Hall and Fagen[3] make this clear in their definition:

> A system is a set of objects together with relationships between the objects and between their attributes.

and

> Objects are simply the parts or components of a system, and these parts are unlimited in variety. Most systems in which we are interested consist of physical parts: atoms, stars, switches, masses, springs, wires, bones, neurons, genes, muscles, gases, etc. We also admit as objects abstract objects such as mathematical variables, equations, rules and laws, processes, etc.

In further discussion of the term "system" Hills states,

> In addition to the element of order, three other components of the concept of system stand out. These are <u>selectivity</u>, <u>abstraction</u>, and <u>system state</u>.[4]

The first of these, selectivity, is a recognition that huge arrays of properties could be identified as descriptive of system X, many of which have no impact on either its operation or output. System, then, encompasses only those objects, relationships, and attributes which

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[2]Ibid. p. 2.

[3]A. D. Hall and R. E. Fagen, "Definition of System," in <u>Modern Systems Research for the Behavioral Scientist</u>. Walter Buckley (Ed.) Chicago: Aldine Publishing Company, 1968. p. 81.

[4]Hills. <u>op cit</u>. p. 3.

effect operation or output. The second, abstraction, conveys the idea that a system has generality, that it encompasses objects, relations, and attributes that are not unique to specific situations. The third component, system state, refers to communication about or description of a system. Hills says,

> A state description of a system is provided by giving specific values to the variables... A state description specifies the particular combination of these values which exists at a given time. (Emphasis added)[5]

The application of these points to the Targeted R&D Program on Reading sets boundaries, albeit abstract ones, for the planning team's term "an instructional system." In this context an instructional system for functional reading competence includes those objects (human and non-human, physical and non-physical), the patterns or sequences in which those objects interact, and the nature (or process) of that interaction. The system has as inputs students and a variety of instructional resources. Its output is individuals reaching age ten who have mastered at least the set of reading behaviors specified by the program criterion instrument.

Hills asserts that

> ...a distinction may be made between (1) units (parts or components, with given properties) on the one hand and (2) relations among the properties of these unites on the other.[6]

This distinction along with his recognition of two categories of components helps clarify the concept "system." The two categories are structural units and process units. The first refers to the physical items that must be included for the system to produce its output, the second, those activities, actions and interactions necessary. "Relations" according to Hills refers to the sequencing and patterning among and between the identified units which is necessary to produce the output desired. That is, it is not sufficient to say that a system consists of people, books, class groups, concepts, drill, memorization, deductive reasoning, classification, equipment, and facilities. There is variation in each of these parts which requires that some people have a relationship with some books, some class groups, some equipment. Others have a different relationship. The system description is not complete until these relations are stated.

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[5]Ibid. p. 4

[6]Ibid. p. 7.

Hall and Fagen indicate that the concept "system" is enhanced by understanding the idea of a system's environment. They define environment as

> ...the set of all objects a change in whose attributes affect the system and also those objects whose attributes are changed by the behavior of the system.
>
> The statement above invites the natural question of when an object belongs to a system and when it belongs to an environment...a system together with its environment makes up the universe of all things of interest in a given context. Subdivision of this universe into two sets, system and environment, can be done in many ways which are in fact quite arbitrary. Ultimately it depends on the intentions of the one who is studying the particular universe as to which of the possible configurations of objects is to be taken as the system.[7]

This point is clarified by these authors through discussion of a high-fidelity sound system situated in a livingroom, a record being played on that sound system, and a listener. To a sound engineer the record, room, and individual are environment. He is interested in the processing of electrical impulses and the creation of mechanical vibrations in general rather than those of a specific record. To someone with different purposes the record, room and individual might be included as a part of the system.

Resolution of the question of categorizing an item as part of a system or its environment is guided by the purpose served by the specific analysis and by four principles of general systems theory. Ryan, synthesizing the work of numerous systems theorists, lists these as follows:

> Principle 1: The greater the degree of wholeness in the system, the more efficient the system.
>
> Principle 2: The greater the degree of systematization, the more efficient the operation of the system.
>
> Principle 3: The greater the degree of compatability between system and environment, the more effective the system.
>
> Principle 4: The greater the degree of optimization, the more efficient the system.[8]

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[7]Hall and Fagen, op. cit. p. 83.

[8]T. Antoinette Ryan, "Systems Techniques for Programs of Counseling and Counselor Education," Educational Technology 9:7-17, June 1969. pp. 9-10.

Wholeness concerns inclusiveness and cruciality of a system's parts. A system is whole when all of the necessary parts exist AND when a change in any one of these parts causes a change in other parts and the performance of the system. Systematization according to Hall and Fagen is the

> ...strengthening of pre-existing relations among the parts, the development of relations among parts previously unrelated, the gradual addition of parts and relations to a system, or some combination of these changes.[9]

Compatability between system and environment is straight forward. It calls for examination of the environment of a system and the modification of the system to create a match so that the system is affected by and affects the relevant items which constitute its environment. Finally, optimization deals with system modification to effectively produce the desired system output.

Creating an instructional system for functional reading competence then requires the identification of the elements of that system and its environment, and the development of that system to a level of wholeness, systemization, and compatability that optimizes the achievement on the part of ten year olds of reading behaviors specified in the program standard. That work is to be initiated in Phase II in part through the refinement and further development of models of the processes of reading, learning to read and language development related to reading. When a model has been developed to the point at which it meets criteria to be stated below, it will be used as a base for deducing, developing, and testing instructional system components.

THE CONCEPT OF "MODEL"

As indicated above heavy emphasis on models is included in this portion of Phase II of the Targeted R&D Program on Reading. As mentioned in Chapter III the term "model" has a variety of meanings some of which are not relevant to this programatic effort. For that reason it was believed necessary to discuss models and modeling in a manner which defines the term as intended by the planning team, to examine the forms in which models are presented, to specify the phenomena to be modeled, and to state criteria which must be met by a model before instructional system component work based on it will be initiated. These points will be summarized below. The reader is referred to Chapter III for additional discussion.

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[9]Hall and Fagen, op. cit. p. 86.

A model is a representation of some phenomenon, physical, abstract, or a combination of the two, which exists in reality. Although common to the thinking of some the Targeted R&D Program on Reading in this definition rejects the use of the phenomenon itself as a model. That is, an example of reading is not a model of reading.

Two classifications of models are sought. The first of these, analogous models, are instances in which a representation is developed which corresponds to reality in its output or performance but does not necessarily contain components that are direct or one-to-one representations of the components of the real phenomenon. The second category, isomorphic models, display this conformance. That is, an isomorphic model has all the parts of the real thing and these parts operate in ways that correspond to the operations in the real phenomenon.

Wallhaus has said, "In fact, replication of reality is not desired, since it will obviate the reason for modeling."[10] This statement would seem to reject the isomorphic model. Such a rejection is, in turn, rejected here for two reasons. First, in the Targeted R&D Program on Reading isomorphic modeling is a sub-Phase goal toward which research efforts are directed. Models which produce reading output similar to that of the real phenomenon through the use of different structures and processes may not be effective as a basis for deducing needed instructional items. The flow charted representation of Goodman's[11] model provides a case in point (See Figure 6, Chapter III of this report). In it a search of memory for items with a given set of grapho-phonological, syntactic, and semantic cues is described. This process is identical to a computer search and list operation and as such is at least analogous to what may be occuring in the brain of a reader. Until further information is available about this part of the real phenomenon a danger exists in deducing instructional procedures. On a logical basis this computer-like search and list can explain how the real phenomenon might work. It does not mean that that is how it does work. If it is only analogous, instruction to cause it may be detrimental. Thus, although an analogous model is helpful in understanding the phenomenon, it cannot be the end of model development.

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[10]Robert A. Wallhaus, "Modeling for Higher Education Administration," in Management Information Systems for Higher Education: The State of the Art. Durham, North Carolina: Duke University Press, 1969. p. 128.

[11]Kenneth S. Goodman, Study of Children's Behavior While Reading Orally. Final Report. USOE Project No. 5-425, Wayne State University, March 1968.

The second reason for pursuing isomorphic modeling has time-and cost-to-the-individual factors. Real phenomena have a time-space component which may be costly for experimentation. With an isomorphic model space can be conserved and time accelerated, decelerated or halted for purposes of examination. These are not often possible when working with the real phenomenon. Further, given such a model, manipulations and modifications are possible that could not be effected with real subjects without possibly subjecting them to undesirable side effects.

Models are presented in one or more formats: verbal statements, pictorial or physical representations, simulation, and mathematics. These are listed in order of utility as perceived by the planning team. Verbal models are not adequate alone. They have great difficulty in presenting simultaneous operations because of the unidimensionality of the expressive medium. This report is a case in point. It recommends that a variety of activities be undertaken simultaneously AND that these activities affect and be affected by each other. It is impossible to verbalize about these different elements simultaneously. Verbal models also fail to adequately handle the quantitative aspects of a phenomenon. Goodman's model indicates that a prediction is made in the reading process, a prediction about what the reader will see next based on what he has seen. Left on a verbal level the intensity of this prediction for forcing a next selection of cues is not explicated and the student of the phenomenon cannot decide whether to place greater importance on that prediction process, on the nature of the next set of cues, the reader's store of information in memory, or what have you. (These points are not made in rejection of Goodman's model, but rather, to recognize that verbal modeling is only a step in the Phase II work of the program.)

Pictorial or physical models include computer flow charts, pictures, and three dimensional objects. Again, the point must be stressed that the Phase II work on models does not reject models of this sort. It is assumed that the development of models progresses through these forms. Pictorial models have an advantage over verbal models in that simultaneous activities can be displayed in parallel. They, like verbal models, are typically weak in representing processes, and quantitative elements in a phenomenon. Simulation and mathematic modeling correct this deficit. If the process elements of a phenomenon have not been accounted for a simulation of it will not operate, that is, the simulation will not function in a way that converts inputs to outputs which parallel outputs of the real phenomenon. In order for a mathematicl model to function, the relationships between elements of the phenomenon being modeled must be expressed as functions of one another and the quantitative aspects of the phenomenon are specified. Simulations and mathematical models are sought in the work of Phase II as they are the communicable and efficient in situations calling for prediction. This focus on simulations or mathematical models combines

with the discussion above of analogous and isomorphic models to serve as criteria which guide the proposed work. The effort in the first part of Phase II are designed to move toward the production of simulations and mathematical models that are isomorphic to the real phenomenon.

The phenomena to be modeled in the Targeted R&D Program on Reading are of three sorts:

1. THE READING PROCESS--the interrelated series of steps, operations or activities of a linguistic, physiological, cognitive, perceptual, and psychological nature that come into play when the organism engages in reading behaviors defined as covert responses to verbal written language. Covert responses are indicated by overt performances which could not have occured without the covert responses to the written language.
2. LANGUAGE DEVELOPMENT RELATED TO READING--the expansion of the individual's semantic, syntactic reservior as instruction in grapho-phonological translation of written language to sound and meaning is provided.
3. LEARNING TO READ PROCESS--the interrelated steps, operations or activities through which the individual moves to achieve functional reading competence.

Wallhaus makes a point that model construction is both influenced by and influences data collection. That is, the specification of the phenomena to be modeled in the three statements above is based on already collected data. In using that data model developers must recognize that their work "...cannot be data driven, that is, entirely influenced by what data are available."[12] He suggests that the model development activity must iterate between model construction and real world data collection activities which check both for the conformance of the developing elements of the model and reality and the exploration of hypothetically possible elements.

PURPOSES TO BE SERVED BY MODELS

Six general uses for models are identified by Wallhaus:

1. They permit feasible and economical experimentation on real-world systems without incurring the costs, risks, and expenditures of time which may be required in actuality.

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[12]R. A. Wallhaus, op. cit. p. 129.

2. They allow us to formulate, communicate, and discuss hypotheses.
3. They bring about an understanding of the system variables and their relationships.
4. They make it possible to forecast and project for planning and decision making.
5. They allow control of the time scale. Real-world processes occur over long periods of time. Modeling can allow long time intervals to be collapsed.
6. To enable us to control and monitor real-world processes.

Two additional uses can be stated. Models make possible exact repetition of an event or activity that is not possible in reality. Finally, models make it possible to stop time and examine the forces or units operating or interacting.

The planning team assumes some or all of these uses in Phase II of the Targeted R&D Program on Reading. The second activity to be undertaken in Phase II is the use of one or more models as the base from which to deduce and invent instructional procedures and materials that contribute to increased functional reading competence. One of three general situations are likely to develop at this point in the program. A satisfactory model of the reading process may exist. Second, a satisfactory model of the learning to read process may exist. Or, third, satisfactory models of both of these processes may exist. The Phase II work to be undertaken differs depending on which of these three circumstances exist. (Note: the planning team recognizes that a model of language development related to reading would be helpful in any of the three circumstances described above. On this basis, work on that subject is requested in Phase I and at the start of Phase II. Modeling of language, language formed long before reading seems possible. Development of models which would represent language development related to reading may not be available by the time models of the reading and learning to read processes are available. When a model of language development related to reading is available any instructional system components that have been invented need to be reexamined in relation to it.)

Given the existence of either a model of the reading process or of the learning to read process, behaviors can be delineated. The program at this point calls for their extrapolation to cover the unspecified behaviors AND for their use in deducing and inventing procedures (and materials where needed) which will generate the identified behaviors. The first case is one in which the terminal behaviors of reading are explicated through the model and what the child must do to develop those behaviors is not known clearly. The second case is the converse. In it a model will exist which delineates behaviors needed to perform a process which is not clearly known. It should be clear that functional reading competence criterion will exist. The third

case, that is, where both kinds of models exist is more desireable than the first two. It permits the detailing of behaviors needed enroute and those desired as terminal. The task here is the direct invention of instructional procedures for generating delineated behaviors.

Before the above uses can be made in the Targeted R&D Program on Reading candidate models must meet the following criteria:

1. Communicability - different scientists must display consistency in describing the elements of the phenomenon and their relationships, and a second scientist can get the same results as a first in applying the model to a specific set of data.
2. Internal Consistency - multiple conclusions cannot be generated when the same set of data is operated on in the model.
3. Data Based - the model's elements and their interrelationships are documented through empirical studies.
4. Predictability - the elements of the model and their interrelationships have been quantified and formulae generated which provide the means for predicting performances that agree with real data.
5. Generality - applicability is confirmed in instances beyond those in which it was developed.

In stating these criteria the planning team recognized that empirical evidence regarding each of these criteria must be generated on each of the candidate models.

SOURCE OF MODELS FOR PHASE II

At the start of Phase II models to be considered for further development and refinement will come from the reports of the literature search and syntheses described in Chapter V. The planning team recognizes that as the work progresses and time passes additional models may develop in activities both within and outside of the funded efforts of the Targeted R&D Program on Reading. It is the responsibility of the program information system to learn of these newly developed models and to propose them for consideration for further work.

Any model that is identified in this manner must be analyzed in a manner similar to the process employed in the literature search efforts. That is, the structural and process components of a new model must be delineated along with the patterning and relationships of those components. The facts known at that point in time and the acceptable assumptions which are relevant to a new candidate model must also be detailed through this analysis. Once this analysis has been completed

by the information system staff, the new model must be compared with those already being developed in the program. This comparison should determine the degree to which a new model duplicates or differs from those already under study. A description of the new model, what is known about its structure and substance, and its relationship to those already under study must be communicated to the program manager and the program's continuing advisory group. Those individuals then have the responsibility for decisions on the support of projects to further develop and refine it.

It is emphasized here that the Targeted R&D Program on Reading must be open to new developments that arise both inside and outside program funded projects. The program assumes continuing basic (non-goal directed) research in reading, psychology, and many other related disciplines which it can tap to improve the probability of attaining the program goal. To operate otherwise would not be in keeping with the Convergence Technique. Scholars in the field must know of and understand this openness. Further, they must know of the continued planning sessions and be invited to make written proposals for modifying the work underway and for new directions.

MODEL DEVELOPMENT AND REFINEMENT EFFORTS

Development and refinement of models is the initial work of Phase II. These efforts cannot be definitively listed until the literature search and synthesis efforts provide a list of candidate models. The planning team did describe five categories of research that must be considered. These categories are described below.

1. Tests to confirm the merger of models--As indicated in the description of the literature search (Chapter V) there is much overlap in the many models that now exist in the literature. This seems to be a result of two things. First, some of the models developed by different individuals or groups are comprehensive models. That is, they attempt to encompass the entire reading process or the process of learning to read. Because of this the same raw data, the same structural and process components, and the same patterns and relationships are involved. The differences that exist in these models are the result of a scholar's insights rather than in differences in the natural phenomenon. The apparent differences between two models reflect these insights on one hand and semantic problems on the other. Gage and Unruh[13] make this latter point clear. They cite the concepts of (a) "entry behaviors" as used by programed learning theorists, (b) "readiness" as used by general educational

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[13] N. L. Gage and W. R. Unruh, "Theoretical Formulations for Research on Teaching." Review of Educational Research 37: 358-370; June 1967.

psychologists, and (c) "pre-existing cognitive structure" as used by cognitive psychologists. Gage and Unruh state:

> These concepts deal with properties of the learner that affect what and how he will learn. Although they differ substantially in emphasis, detail, and hypothesized modus operandi, they have much in common and ought to be collated.[14]

The planning team believes that models that have commonality in structure, process and relationships can and must be merged into a single model. This work is proposed and will be carried out on a logical analysis basis in the literature searches.

The second contribution to multiplicity of models and apparent overlap among them stems from the choice of some scholars to concentrate on a part of a phenomenon. Reading involves visual perception, written messages, and mental processing. Models of each of these exist. These three items are not discrete but interactive. Thus, sharp boundaries do not exist between them. Because of this a model of one of them may have considerable overlap with another. Consider for example, perception and mental processing. Perception involves but does not encompass mental processing and vice versa. A change in one affects the other. These points support the assertion that they are partial models--models of subsystems, and that there is overlap. Again, the planning team has called for merger where possible on the basis of logical analyses in the literature search efforts.

The program cannot proceed long on the basis of logical analyses and syntheses. The planning team accepts this only as part of the initial (Phase I) effort and calls for empirical tests of the logic of the mergers early in Phase II. This is the first category of research in the refinement and development of models.

The planning team does not assume that the logical synthesis of models and the empirical validation of that logic will result in only one model on which further work will focus. Nor did they rule out that possibility. They anticipate that the literature search will identify fifty to sixty model or partial model presentations. After the logical analysis it is unlikely that more than three or four comprehensive models and eight or ten partial models will be proposed for further work. Alternative models of the same phenomenon are to be accepted at this point if their differences are displayed through a delineation of different structural and process components and patterns,

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[14]Ibid. p. 366.

differences which might occur through the acceptance of different sets of basic assumptions about the modeled phenomenon.

The completion of empirical tests on the logic of the mergers made in the literature search will yield one or more models to be further refined and developed. All of the models discussed by the planning team exist in a verbal or verbal-pictoral form. Each model validated through the work already described will be the subject of four additional types of study. Again, specification of these research efforts is deferred until the candidate models have been examined as described above. At that time the program management will convene a planning group and charge it with the task of specifying the individual research projects to be conducted. Given that specification, requests for proposals will be announced to the field. The other four categories of research are:

2. Tests of hypotheses regarding the structure of a given model--One of the contributions of the literature search report is a listing for each model which indicates which of its components are soundly based on empirical evidence and which are at this time hypothetical. Research must be planned and carried out which will confirm and/or reject these hypothetical elements. (Example: The process of learning to read has been described by many as the development of sequence of skills and understanding. It is anticipated that one of the models that will progress to this point will include this concept of "sequentiality." Empirical evidence has not been generated which would confirm or refute this sequence hypothesis. The planning team interprets sequence in this case as an hypothesized structural aspect of a model of the learning to read process, one that needs to be empirically tested.)

3. Studies that define constructs included in a model--It is anticipated that thypothetical constructs will be involved in the models that reach this stage. Those constructs will have been listed and research proposed which will empirically define them. (Example: The Gray-Robinson model lists as one of its elements, "Fusion of ideas read with previous experience." This is a logical component in the context of that model. It has not been examined empirically to date to determine either what it includes or excludes.)

4. Studies which develop each model's calculus-of-operation--This phrase refers to the mathematical quantification of the components of a model and the development of formulae which express the interaction of components. The models which enter this stage of the Targeted R&D Program on Reading are likely to be verbal or verbal-pictorial representations of the phenomena studied. In such a model neither the variation in a component nor the interrelationship among components is specified.

Studies must be undertaken which will quantify their elements and develop simulations or mathematical formulations for their interrelationships. The successful completion of this work is required before a model can be operated and its operation and output checked for conformity with reality. (Examples: The models of the reading process examined indicate an eye-movement component. That component has variation which has not been quantified for reading. Some of the models indicate a component in the reading process called motivation. As described it has intensity (in both positive and negative directions) that must be quantified to permit complete definition of the model. Some of the verbal models hypothesize an interaction between eye-movement and motivation. The mathematical formualtions needed to account for this interaction need to be developed.)

5. Tests of a model's predictive capability--The planning team assumes that a model's utility for inventing instructional system components is directly related to the conformance between operational and output data of the model and of the real phenomenon. That is, as a model is operated observations should be possible which describe that operation. Those observations, if the model is a good one, should be in agreement with observations of the real phenomenon. The same holds for output. The degree to which agreement is obtained is an index of the model's predictive capability.

As work progresses in these four categories, the program manager must continually ask the question, is model X ready to be used in the next activity, the design and invention of instructional system components? The answer to that question is based on the degree to which a given model satisfies the subphase criteria of communicability, internal consistency, data based, predictability, and generalizability. Some of the data necessary for this decision will be generated in the categories of research described above. The remainder must be generated through additional projects. Communicability is a case in point. The studies undertaken in the categories described above are not likely to produce evidence as to the agreement of different scientists on the nature of a model's structure, process, and patterns. Generalizability is another. In its development a model may take on structure that is inherent in a given institution or subjects. If that structure does not apply for other institutions or subjects, the model is of little utility. Where empirical evidence is not available regarding any of these criteria, projects must be established to generate it in support of the program management decisions.

DESIGN AND INVENTION OF INSTRUCTIONAL SYSTEM COMPONENTS

Models which satisfy the criteria of communicability, consistency, data based, etc., are ready to be used in the design of instructional system components. The products of this work will be parts, components or elements of an instructional system which contributes to improved attainment of functional reading competence. It is anticipated that few, if any, will be sufficient in attaining all the behaviors necessary for the criterion performance specified on the part of the entire population. This partiality of accomplishment is displayed in the cross-break below.

CATEGORIES OF INSTRUCTIONAL SYSTEM COMPONENTS TO BE DEVELOPED

	BEHAVIORS DEVELOPED	
TARGET POPULATION WITH WHICH COMPONENT HAS WORKED	PART OF CRITERION	ALL OF CRITERION
SUBSET	A	B
TOTAL	C	D

It is not likely that category D is a real category. It is hard to conceive of a single-component instructional system that will accomplish all of the required behaviors with the entire population. It is probable that components will be developed that will achieve part of the objectives with part of the population; that others will be developed that achieve that same or other parts of the objective with the total population; and that still others will be produced which will be effective in generating all of the criterion behaviors with a part of the population.

Any instructional system component developed at this stage of the Targeted R&D Program on Reading must be accompanied by diagnostic and measurement tools. If a component is proposed as effective for a part of the population, its use requires the ability to identify the members of that subset. Thus, it must be accompanied by selection or screening tools. If a component proposed for the system is effective with a part of the criterion behaviors, its effective use requires the ability to determine when learners are at the point where that component is useful. Thus, a tool for assessing the progressive accomplishment of the desired behaviors is required.

The methodology of the creation of instructional system components is not clear. This is a development activity and the process of development has not been made explicit in the literature. For another project[15] the principal investigator on this Convergence Technique application made a search of the literature for articles that describe the development process. That search, covering a ten year period (1958-1968), identified numerous articles that described the results of a development effort. Very few of these concentrate on the development process itself or give an extensive enough chronology of the work to make an analysis of that process possible. The few articles which do discuss the development process are of little help for as Nadler has said, "Although different words may be used, the design steps or process suggested are called the 'scientific method' or 'problem-solving method.'"[16] Their description of development is the same as descriptions of the research process. At the same time there is a recognition that the two processes serve different functions. Nadler asserts that

> ...to be optimally effective, design practice (especially engineering design) requires a methodology that is significantly different from the research approach for developing knowledge and establishing verifiable general laws.[17]

The basic difference between research and development, as implied above, is in the functions served. Research is conducted to generate knowledge about something that is unknown. This calls for a concentration on a part of a system. Engineering design or development focuses on wholes. All the necessary parts must be assembled to fulfill a function if a development effort is to be effective. Nadler cites four problems which arise when the research process approach is used in a situation calling for development.

> In the first place, analysis, which is so essential for research, implies already existing phenomena to be analyzed. The designer seeks purposeful function through <u>new</u> and <u>different</u> combinations of phenomena.

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[15]Egon G. Guba, Training Materials for Research, Development, and Diffusion Training Programs. Cooperative Research Project No. 8-4501 (In process) 1970.

[16]Gerald Nadler, "An Investigation of Design Methodology," <u>Management Science</u> 13:B-642-655; June 1967. p. B-643.

[17]Ibid. p. B-642.

> Second, the analytical (research) approach focuses on components rather than on wholeness. Attention to components is essential in research, but in design it very often leads to suboptimization for the entire solution.
>
> Third, analysis leads to an overemphasis on techniques to seperate the whole into constituent parts or elements. This can lead the designer to seek opportunities to apply the techniques, rather than to seek an optimum design for a particular problem.
>
> Fourth, the emphasis on analytical tools creates a gulf between those people in an organization who possess the technical expertise to handle the tools and the majority who do not.[18]

To counter these problems Nadler defines the term "design," examines several cases in which design or development was central, and proposes ten elements for a design methodology. The definition and methodology he proposes is a concise statement of the planning team's discussion of the work involved in the invention of instructional system components. Design he says, is

> ...the act or art of making

which involves,

> ... the multidimensional (physical, state, and rate) specification of the precise conditions for each of the characteristics (function, inputs, outputs, sequence, environment, equipment, and human agents) of a system.[19]

The creation of instructional system components is an act of making. The planning team anticipates that developers will start with an established model; identify isolable components of the model; determine the function of that component; and specify and create the necessary inputs, outputs, sequence, environment, equipment, and human agents necessary to serve that function.

The methodology of design proposed by Nadler is based on case study analysis of development efforts and work done by

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[18]Ibid. p. B-644.

[19]Ibid. p. B-643.

the Conversion-to-Practice Research Group at Washington University in St. Louis. Its structure and logic is sufficiently parallel to the discussions of this Convergence Technique application planning team that it is suggested as guidance for the development work in this programatic effort on reading. Contractors will be asked either to follow the steps in this design methodology or propose logical modifications of it, presenting the logic, and where possible, empirical evidence in support of the change.

Nadler's development methodology has the following components:

(1) Function determination. The mission or purpose of the system, and of the higher level systems of which the project system is a part, are identified to select the highest level function.
(2) Ideal system development. Several very high level and advanced systems (or products) are developed. One of them is selected to serve as a guide for developing a recommended solution. ...These ideal systems are actually designed - not just discussed in the abstract.
(3) Information gathering. The process of selecting an ideal system raises many questions related to the design of a system, its manner of implementation, basic organizational data, and so forth.
(4) Alternative systems suggestions. The information gathered will show that some of the components of the ideal system will not be feasible as designed. Thus, alternatives need to be developed which will conform as closely as possible to the ideal system.
(5) Select the feasible solution. Basic evaluation factors, such as economic, hazard, control, psychological, and organizational factors are used to select the recommended system or solution.
(6) Formulate the system or solution. The exact details of the solution are prescribed in this step. All of the design paramaters must be precisely specified in their multidimensional form.
(7) Review the system design. Other persons as well as the designer need to reexamine the system design to avoid premature installation, correct details, and determine if it is at all possible to move closer to the ideal system.
(8) Test the system design. Because a few components of the recommended system require verification in real life, the test step is used.
(9) Install the system or solution. The changes or new items must be ordered, people must be

trained, and shakedown or debugging activities must be arranged.

(10) Performance measures established. A measurement is made to determine how well the object of the project has been met, and to establish the operating expectations of the system or solution.[20]

It is recognized that a sequence seems implied in the steps in this design approach. That sequence is an artifact of its presentation here. In operation this approach is iterative. Work at one level may make it necessary to move to either an earlier or later step. For example the test of the design (8), in effect a trial run, may show that the selected feasible solution (5) was in error, the trial run does not work. Given such an observation the developer must return at least to steps (3) and (4) information gathering and alternative systems suggestions. In doing so he has now gained additional information through his failure.

The application of this methodology to the creation of components for a functional reading competence instructional system requires understanding the following points. First, the design work is to be based on specific models. These models are not representations of the instructional system nor of its components. If a model of the reading process is available as a basis for development, the model is a representation of the output or product. In that case the design effort starts with an examination of the model to determine the nature of the behaviors and knowledge necessary to engage in the reading process. The designer must then make assumptions about how those behaviors are learned and use those assumptions in the design of instructional system components. If the available model represents the process of learning to read a similar problem exists. The items to be created are components of the instructional system while the model is a representation of the learner's tasks.

The designer must also understand that the item he is developing is a component or subsystem of a larger instruction system. Although he is not asked to develop the entire system his work must take into account the general nature of other components that might be included. Any products he designs and finds successful must be accompanied by a general description of the entire system, the locus of the developed component within that system, and the data generated in the establishment of performance measures (Step 10 in the design methodology).

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[20]Ibid. pp. B-647-B-648.

PROCEDURES TO BE FOLLOWED WITH PROTOTYPE INSTRUCTIONAL SYSTEM COMPONENTS

Phase II of the Targeted R&D Program on Reading has one more general activity, independent confirmation of the effectiveness of developed instructional system components. The development work to be carried out will produce components which have worked under the control of their developer. Before they can be accepted as candidate components for instructional system design, their effectiveness in other settings and under the control of other individuals must be determined.

The planning team has set the following as criteria for these independent confirmation tests:

1. Communicability. The nature of the instructional component, its function, inputs, outputs, sequence, environment, equipment, and human agents must be understandable to a sample of the individuals representative of the users of that component.
2. Proven effectiveness. Data generated on the use of the instructional system component with a sample of the target population confirms its effectiveness in developing functional reading competence.
3. Robustness. The component must display effectiveness in settings which display variation in variables that are not central to the component.
4. Economic feasibility. The costs for operating the component must be determined and be within the expenditure levels set in the Phase I analyses.

Further discussion of the independent confirmation tests will be presented in Chapter XI of this report.

SUMMARY

Concurrent with adaptive experimentation in ongoing reading instruction programs, Phase II of the Targeted R&D Program on Reading calls for the development of models of the processes of reading, learning to read, and language development related to reading. Five categories of research deemed necessary in the development of such models have been presented. Models developed through these efforts are to be used as the basis for the development of components for a functional reading competence instructional system. The concept of system basic for this work and a methodology for the development efforts was discussed. Through this work effective components for an instructional system will be generated. After a confirmation test of these components they will serve as the inputs for instructional system design. Those independent confirmations and system design activities are to be detailed in other sections of this report.

CHAPTER IX

ADAPTIVE EXPERIMENTAL LABORATORIES ON READING INSTRUCTION

(PHASE II ACTIVITY)

The second major path to functional reading competence lies in the systematic improvement of reading instruction. The planning team recognized that for decades attempts have been made to improve such instruction. Those attempts have not, however, employed a systematic strategy. The approach proposed here parallels a suggestion made by Richard Schutz regarding the development of training programs for educational researchers.[1] Schutz stated:

> The strategy is built on the premise that no training program will be completely effective and efficient in its first cycle of operation. This ineffectiveness or efficiency is not a cause for concern as long as it is identified. One begins with a full realization that while the present program is the best that can be offered, many modifications will be required before the program begins to reach the desired level of impact.
>
> The self-corrective mechanism basic to the strategy has proved applicable in a wide range of scientific enterprises. From one point of view the strategy is nothing more than the small "s" in scientific method in operation. Self-corrective mechanisms have the following characteristics:
>
> 1. An established, operationally-defined set of objectives;
> 2. A means of evaluating discrepancies between the objectives and the current performance of the program;
> 3. Procedures for changing the program to minimize the discrepancy (p. 43).

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[1]Richard E. Schutz, "Strategy for the Development of Training Programs for Educational Researchers." Preparation of Research Personnel for Education. David L. Clark & Blaine R. Worthen, Editors, Bloomington, Indiana: Phi Delta Kappa & American Educational Research Association, 1967.

The planning team proposes the establishment of approximately six Adaptive Experimental Laboratories (AEL's) each of which would start with a different approach to the teaching of reading. Each laboratory would consist of an on-going reading instruction program augmented by personnel with expertise in the area of reading, research, and evaluation. Each laboratory is to follow a six point operational procedure.

1. Specification of the reading behaviors to be produced by instruction;
2. Observation and recording of the instructional procedures and materials used and of other possible influences on the process of learning to read, even if outside the AEL;
3. Measurement of the outcomes of the instructional program;
4. Analysis of the discrepancy between behaviors sought and outcomes;
5. Modification of the instructional program based on this analysis; and
6. Recycling until the TRDPR standard of functional reading competence is met in the on-going reading instructional program of the laboratory.

The specification of behaviors (item 1 above) will at the outset of an AEL's work be based upon the understanding of the reading process as it exists in the minds of the personnel who will staff it. Those persons will be provided with the syntheses of literature on reading, learning to read, and language development related to reading (Phase I activities). Given this informational input an AEL staff is expected to re-examine, and where appropriate, restate the reading behaviors sought as their instructional goal. When the criterion instrument development activities prescribed in the TRDPR plans are completed, the AEL staff is again expected to examine and modify their instructional goals.

One of the difficulties seen in current and previous research on reading instruction is its failure to observe and record what transpires as instruction proceeds. Typically, a procedure, approach, or set of materials is described as the basis of a study; it is set in motion and achievement results are catalogued. The interaction that occurs between the teacher, materials (and/or approach), and students defines the reading instruction that <u>actually</u> takes place. Item 2 in the listing above asks for the generation of data for the accurate description of the actual process of reading instruction. The planning team believes these data are a necessary part of the operation of an AEL.

Measurement of the outcomes of instruction (item 3 above) will invlove the use of existing measurement procedures at the outset of the AEL program. As soon as the TRDPR instrument development activities produce a valid and reliable measure each AEL will use it to assess outcomes. This does

not imply that other measuring devices cannot also be used in an AEL. Nor does it preclude the development of additional measures for the express use of an AEL.

Items 4 and 5 above are the heart of an AEL's operation. They propose the implementation of an evaluation and planned change procedure such as that proposed by Stufflebeam.[2] Evaluation, according to Stufflebeam, involves monitoring the system for its operation within specified limits on identified parameters; weighting the potential benefits of alternative modes of operation when the system monitoring indicates a need for change; and, systematic study of both the process and product on any (or all) selected alternative operation modes.

Given the implementation of the above procedures, each AEL is expected to recycle through the five previous steps until the program goal is met. The planning team recognizes and anticipates partial meeting of the goal, partial in either of two senses. First, the goal of functional reading competence may be met completely through specified procedures for a subset of the population. And second, AEL developed instructional procedures might be successful with the entire population on a subset of the behaviors which comprise the program goal, functional reading competence. In either case valid instrumentation for measuring this partial achievement must also be developed.

Schutz states several attributes to such an approach.

1. It permits the initiation of action at any level of efficiency. Argument concerning the goodness or badness of a program are obviated. One simply starts at the best-guess arbitrary point he can. (This program will reduce some of this arbitrariness by basing selection of approaches on the literature search.)
2. It requires one to state specifically what he wants to accomplish. Although researchers give a good deal of lip service to behavioral objectives, such statements are exceedingly rare. The continual refinement of objectives is an important aspect of the self-corrective loop so that here too there is inherent provision for improvement.
3. It focuses attention on improvement rather than on immediate perfection. If one's criterion is immediate perfection, he is likely to be very

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[2]Daniel L. Stufflebeam, "Evaluation as Enlightment for Decision Making." Improving Educational Assessment & An Inventory of Measures of Affective Behavior. Walcott H. Beatty, Ed. Washington, D. C.: Association for Curriculum Development, NEA. 1969.

defensive concerning any possible deficiencies. He tends to resist rather than to welcome change, since change is an open admission of inadequacy. The self-corrective strategy reflects a directly opposite attitude. It encourages rapid but direct change.

4. It gives appropriate emphasis to divergent and convergent thinking efforts. The strategy encourages creativity, but directs it toward the converging attainment of specified objectives.
5. It is product oriented. Thus, the strategy obviates the need for the "basic research" - "field demonstration" conceptual continuum. The self-corrective mechanism is applicable to each level of this continuum. (p. 44)

The goal in each of the Adaptive Experimental Laboratories is the production of a reading instruction curriculum which, in that setting, achieves all or part of the TRDPR program standard with ten year old children.

CRITERIA FOR ESTABLISHING ADAPTIVE EXPERIMENTAL LABORATORIES

As indicated earlier the planning team projected the establishment of about six adaptive experimental laboratories, each of which is to operate a different approach to reading instruction. Four approaches were tentatively identified in the discussion of the planning team. The tentativeness of this identification is based on two things. First is the assumption that a search of the literature on reading instructional practices will more clearly define apparently effective approaches. Second, to date conclusive evidence of the superiority of one reading instructional approach over another has not been found. The four approaches are: (a) a behavioral modification approach to the teaching of reading; (b) an early enrichment approach to the teaching of reading; (c) a sociolinguistic approach to the teaching of reading; and (d) a reading program featuring clinical analyses of individual failures.

To be eligible as an Adaptive Experimental Laboratory an institution or group of institutions would have to meet or agree to the following:

1. Follow prescribed data collection and report procedures as specified by the TRDPR information system.
2. Exhibit potential for access to subjects with a wide range backgrounds.
3. Operate within program oriented goals.
4. Provide research, evaluation, reading, and management staff with appropriate training and experience.

5. Handle a number and variety of students sufficient to demonstrate the effectiveness of the instructional system which evolves.
6. Specify opportunities to work in and modify instructional processes in real world school environments.
7. Utilize funds from other sources to the extent possible.
8. Agree to implement deductions for improving techniques derived from either their analysis of their on-going program or from other elements in the TRDPR program.
9. Must agree to start with a designated instructional system.

Staffing of an Adaptive Experimental Laboratory must include administrative and managerial positions, reading specialists positions, and research and evaluation positions. This staffing should include a composite of competencies in the area of reading, reading instruction, language, and associated skills in research design, measurement, curriculum evaluation, and systems analysis.

The planning team conceived of a laboratory existing either solely within one institution (e.g., a public school system) or a combination of institutions (e.g., the university, a regional laboratory and one or more school systems). In either case the purpose for the laboratory as stated above must be paramount and the criteria and procedural specifications must be met. Financial support is to be provided for the research, evaluation and reading expertise involved in a laboratory but not for the on-going reading instructional program. Special equipment may be necessary in some cases. Only in those cases should such equipment come from contract funds.

TRDPR ACTIVITIES RELATED TO ADAPTIVE EXPERIMENTAL LABORATORIES

As is shown in the detail of Phase II Subobjectives and Criteria (Figure 15), two activities are proposed in the AEL line of the program. The first of these is primarily administrative in nature while the second is operational.

In the first, the TRDPR management personnel in consultation with specialists in reading and evaluation will set the specifications for an AEL. These specifications collectively will detail the overall scope of the AEL program by presenting detailed descriptions of the reading approaches involved and by setting boundaries on size of the reading program to be encompassed within an AEL, the number and kinds of staff to be supported by a TRDPR contract, the reporting and operational standards to be met, and the criteria which must be met both to

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR

PHASE 2--SUBOBJECTIVES & CRITERIA

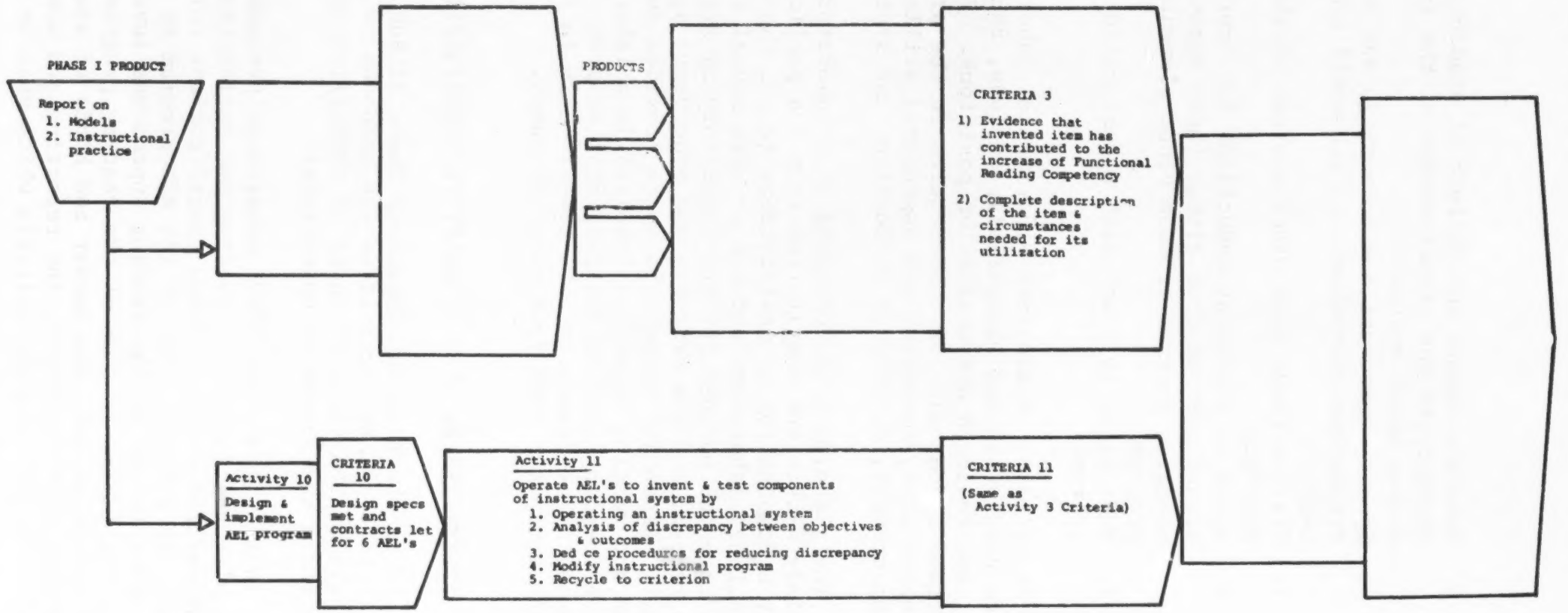
PHASE I PRODUCT
Report on
1. Models
2. Instructional practice
PRODUCTS
CRITERIA 3
1) Evidence that invented item has contributed to the increase of Functional Reading Competency
2) Complete description of the item & circumstances needed for its utilization
Activity 10
Design & implement AEL program
CRITERIA 10
Design specs met and contracts let for 6 AEL's
Activity 11
Operate AEL's to invent & test components of instructional system by
1. Operating an instructional system
2. Analysis of discrepancy between objectives & outcomes
3. Ded ce procedures for reducing discrepancy
4. Modify instructional program
5. Recycle to criterion
CRITERIA 11
(Same as Activity 3 Criteria)

Figure 15.

continue operation as an AEL and to satisfy the program objectives.

Given an approved set of specifications, Requests For Proposals are to be circulated broadly. These RFP's must make clear the fact that this work is to be part of an on-going programatic effort and that obtaining one of these contracts entails acceptance of responsibility for meeting program specifications for reporting and procedure.

The second activity shown in Figure 1 is AEL operation as described earlier in this chapter. Each AEL initiates its operation as soon as a contract is processed. Its overall goal (and TRDPR subgoal) is the development of instructional approaches, procedures, and/or materials and to generate data adequate for determing whether their use resulted in increased functional reading competence.

The criteria for this work as stated by the planning team are:

> There must be evidence that there is a defined instructional procedure which:
> 1. Applies to all students; or
> 2. Applies to some specified subset of students and a valid diagnostic procedure to identify the subset is available; and
> 3. The procedure increases functional reading competence as measured by the program goal instrument.

This statement implies description of the instructional approach and materials which is complete enough to make possible their use in other settings without the necessity of further work on the part of staff members involved in their development. The statement makes explicit the expectation that solutions leading to the achievement of the program goal will probably come by developing effective procedures (and/or materials) for a subset of the target population or for a subset of the behaviors which comprise functional reading competence. It further recognizes that any partial solution must be accompained by tools which make possible the identification of the subset of the population or the accomplishment of the subset of functional reading behaviors on which that solution focuses.

As indicated in the overview of the program (Chapter II), any items which meet these criteria are considered as prototype items, not as finished work. Before they can be considered as candidates for inclusion in a TRDPR developed reading instruction system, they must be subjected to and pass confirmation tests, trials in different settings without the involvement of their developers. Details and rationale for these independent confirmations is presented in Chapter X.

CHAPTER X

INDEPENDENT CONFIRMATION OF PROTOTYPE INSTRUCTIONAL SYSTEM COMPONENTS GENERATED THROUGH MODELS OR ADAPTIVE EXPERIMENTATION ON READING INSTRUCTION

The focus of the discussion below is on an activity called independent confirmation of the utility of components for a functional-reading-competence instructional system. That activity is a part of the Targeted Research and Development Program on Reading, a cummulative programatic R&D effort to achieve a goal of functional reading competence on the part of all persons reaching age ten who are not in permanent care institutions.

This independent confirmation activity has some boundaries which must be understood. It is preceded by work which will have developed components for an instructional system through either of two activities: the use of models of the processes of reading, learning to read, and language development related to reading; or adaptive experimentation with selected reading instruction programs. Independent confirmation is also preceded by the development of measurement procedures which will validly assess the attainment of functional reading competence. The independent confirmation activity is to be followed by work which merges effective instructional components into a complete system for developing functional reading competence.

The products of the work with models and with reading instruction programs cannot now be listed and described specifically. Those details await the completion of work in Phase I and the first part of Phase II of the Targeted R&D Program on Reading. They can be described generically. Since such a description sets the stage for the independent confirmation activity, it is presented here.

NATURE OF THE ITEMS TO BE SUBJECTED TO INDEPENDENT CONFIRMATION

The overall goal of the Targeted R&D Program on Reading is an effective instruction system. That system may be similar in form to what now exists in that it involves groups of children under the tutelage of adults in a formal institution, or it may be of some quite different form. Its ultimate form will be determined as Phase II progresses. It can be assumed that the functional-reading-competence instructional system will consist of numerous subsystems or components. The work of the modeling and adaptive experimentation lines (Figure 16) will produce instructional system components some of which may eventually make up the desired instructional system. The tentativeness stated here is a recognition of two constraints. First, developments that have worked in the hands and setting of the developer may not be effective when used by others or in other settings. Second, the assembly of a system from a variety of components may not involve all of the available items. The first of these constraints is the focus of this chapter. The second is discussed elsewhere.

Although it was not possible to describe specific components that would be subjected to independent confirmation a description of their general characteristics has been developed by the planning team. Each developed component will be considered complete and ready for confirmation when two conditions have been met. First, the developer has generated data through the use of the component with an available sample and those data indicate it is effective in developing all or part of the functional reading criterion behaviors. Second, reports are available which describe the following:[1]

1. An outline which suggests the nature of the complete system in which the component is a part.
2. The function to be served by the component. (Function in this context explicates what is to be accomplished by the component. What purpose is to be served.)
3. The inputs necessary for the component to function. (All of the things that are inserted and changed to become an output. For example, in the case of a component which has as its function the development of a specific knowledge, students and information are inputs, the paper on which prerequisite information is printed is not an input. It is not changed in the process.)

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[1]The format of items 2 through 8 are paraphrased from writings by Gerald Nadler with his permission. See for reference, Gerald Nadler, "An Investigation of Design Methodology." Management Science 13:B-642-B-655; June 1967.

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR

PHASE 2--SUBOBJECTIVES & CRITERIA

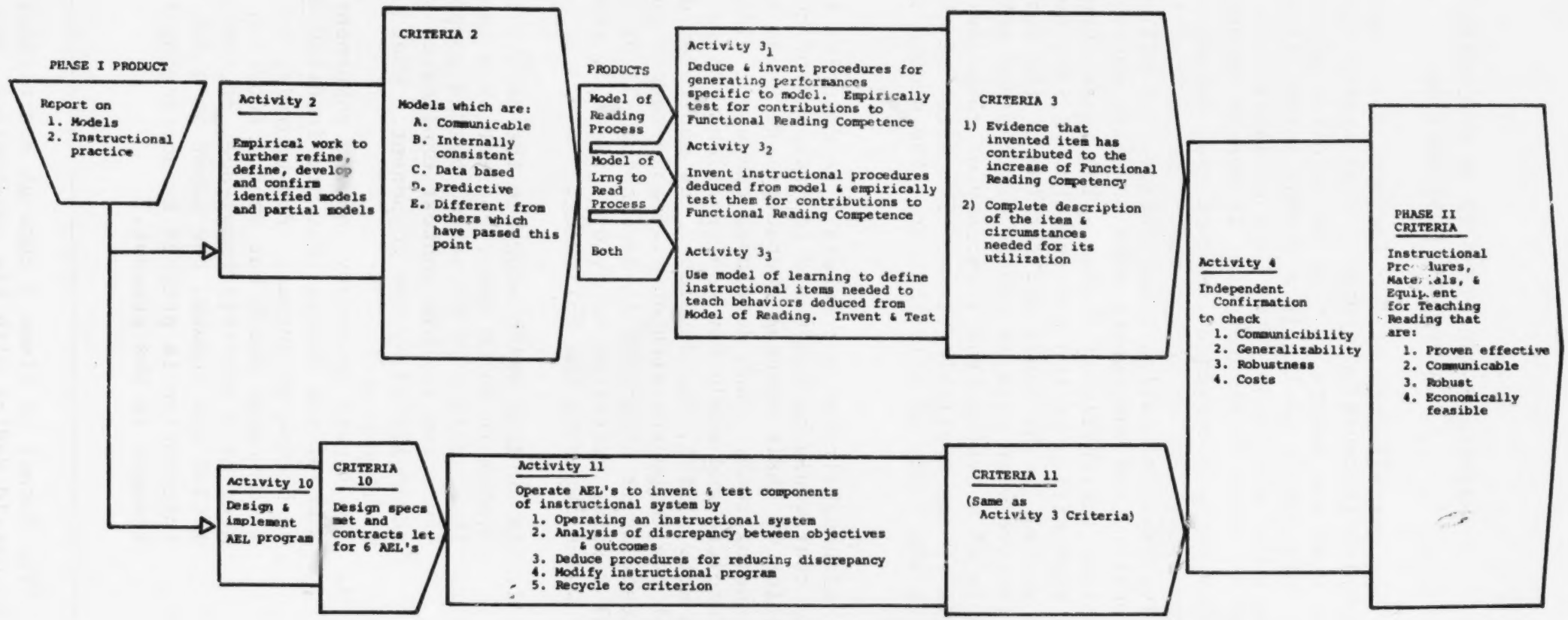
PHASE I PRODUCT
Report on
1. Models
2. Instructional practice
Activity 2
Empirical work to further refine, define, develop and confirm identified models and partial models
CRITERIA 2
Models which are:
A. Communicable
B. Internally consistent
C. Data based
D. Predictive
E. Different from others which have passed this point
PRODUCTS
Model of Reading Process
Model of Lrng to Read Process
Both
Activity 3₁
Deduce & invent procedures for generating performances specific to model. Empirically test for contributions to Functional Reading Competence
Activity 3₂
Invent instructional procedures deduced from model & empirically test them for contributions to Functional Reading Competence
Activity 3₃
Use model of learning to define instructional items needed to teach behaviors deduced from Model of Reading. Invent & Test
CRITERIA 3
1) Evidence that invented item has contributed to the increase of Functional Reading Competency
2) Complete description of the item & circumstances needed for its utilization
Activity 4
Independent Confirmation
to check
1. Communicibility
2. Generalizability
3. Robustness
4. Costs
PHASE II CRITERIA
Instructional Procedures, Materials, & Equipment for Teaching Reading that are:
1. Proven effective
2. Communicable
3. Robust
4. Economically feasible
Activity 10
Design & implement AEL program
CRITERIA 10
Design specs met and contracts let for 6 AEL's
Activity 11
Operate AEL's to invent & test components of instructional system by
1. Operating an instructional system
2. Analysis of discrepancy between objectives & outcomes
3. Deduce procedures for reducing discrepancy
4. Modify instructional program
5. Recycle to criterion
CRITERIA 11
(Same as Activity 3 Criteria)

Figure 16.

4. The outputs created by the functioning of the component. (Outputs are those products which occur; the results of the functioning of the component. A properly functioning component will display congruence between function to be served and outcomes.)
5. The sequence, processes or procedures involved in the operation of the component. (Lectures, drills, memorization, inductive and deductive analyses, diagnostic procedures, etc. are included in this characteristic.)
6. The environment of the component. (A system component operates in an environment which consists of "...all objects a change in whose attributes affect the system and also those objects whose attributes are changed by the behavior of the system."[2])
7. The physical catalysts involved in the component. (Equipment, materials and things are physical catalysts. In the example used in 3. above, if an opaque projector were used to display the information on the paper, that projector would be a physical catalyst in this instructional component. Tests to determine mastery would also be interpreted as catalysts.)
8. The human agents required in the operation of the component. (Teachers are human agents in most existing instructional system components. They are a part of and make the component work (or fail to work) without being changed in the process. Learners are not human agents because they are changed. The use of teachers as the example here should not be interpreted as the expectation for the proposed work. Human agents may be teachers, parents, social workers, peers, siblings, etc.)

As stated earlier these items are components of a system for development of specified behaviors. The partialness implied therein has two aspects. The first aspect involves the behaviors to be developed through the program. The component may develop only part of the specified behaviors or it may develop behaviors necessary to master one or more in that terminal set. The second aspect concerns the population on which the Targeted R&D Program on Reading focuses. Some components may be developed which are effective with some subset of that population.

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[2]A. D. Hall and R. E. Fagen, "Definition of System," in Modern Systems Research for the Behavioral Scientist. Walter Buckley (Ed.) Chicago: Aldine Publishing Company 1968. p. 83.

When either of these situations exist, the planning team recommends that a component not be considered unless measurement procedures are also available. If a component develops a single behavior or enroute behaviors, measures must be available which assess the learners readiness to use this instructional system component AND his mastery of the learning for which the component is perportedly effective. When a component is developed for a population subset measurement procedures for categorizing learners into or outside that subset must also be developed.

When the eight items listed above and the necessary measures are substantiated with data, the program managers have an instructional component ready for independent confirmation.

THE NEED FOR INDEPENDENT CONFIRMATION

Newly developed instructional system components are subject to four kinds of weaknesses. A development program that rushes from component design directly to implementation risks failure that cannot be permitted in the Targeted R&D Program on Reading. To avoid those risks the planning team inserted an activity which is designed to uncover these potential weaknesses and permit program managers either to exclude developed instructional system components which have them in further activities of this programatic effort or to return them for further development.

The potential weaknesses of a component are:

1. Some instructional system components have been developed in a way which makes the developer himself a part of the component. Attempts to operate such a component without the developer are doomed since the developer cannot participate in widespread application.
2. An interaction between a newly developed instructional component and the institution in which it is developed may make it ineffective in other settings. This point has been made frequently in regard to instructional approaches developed in university laboratory schools.
3. A development that is complex and/or abstract is frequently difficult to communicate. In such a case implementation of it is either impossible or incomplete resulting in the failure of the development to work as it was intended.
4. Some components for instructional systems have costs either directly in dollars or indirectly in personnel, facilities or time that cannot be met in user institutions.

Instructional systems built up from components which are prone to any of these problems are not likely to be broadly effective.

The independent confirmation activity built into the Targeted R&D Program on Reading is designed to generate data on:

1. Communicability. The nature of the instructional component, its function, inputs, outputs, sequence, environment, equipment, and human agents must be understandable to a sample of the individuals representative of the users of that component.
2. Proven effectiveness. Data generated on the use of the instructional system component by someone other than the developers with a sample of the target population confirms its effectiveness in developing functional reading competence.
3. Robustness. The component must display effectiveness in settings which display variation in variables that are not central to the component.
4. Economic feasibility. The costs for operating the component must be determined and be within the expenditure levels set in the cost analyses undertaken in Phase I.

Given these data, program managers and consultants will have the information necessary to build up a collection of components which may be considered in the Instructional System Design and Test Phase of the program.

NATURE OF THE INDEPENDENT CONFIRMATIONS

The discussion above sets some of the characteristics of the independent confirmation activity by describing the needed data. The planning team discussed other aspects of this activity.

First, a confirmation effort must involve samples of learners and settings that are sufficiently large and diverse enough to warrant generalizations. The exact nature of the sample must be determined in conjunction with the component studied. One that is designed to work with Indians residing on a reservation would be tested on a sample different from another component developed for middle class suburban eight year olds.

Confirmation studies must be designed with the recognition that two populations are typically involved in a learning situation, the learner and the instructor. Sampling procedures and project designs must make it possible to make generalizations about all of the involved populations.

The planning team's insertion of a robustness criterion calls for a sampling of settings and subjects which needs some discussion. In the development of an instructional component

a description of that component and its environment are called for. Robustness is the degree to which a component produces its designed output when characteristics of its environment are varied. If variations in environment cause a reduction in the effectiveness of a component it cannot be considered for instructional system design. There is an exception to that rule. That exception covers those cases in which there is apparent promise that further work might show a specific set of environment characteristics in which the component is effective.

The independent confirmation activities must involve widespread efforts. These must be centrally designed, administered, and analyzed. Plans for any confirmation must attend to these matters in advance.

The determination of the effectiveness of a component has two elements. Data must be generated which validly describes outcomes and process. The independent confirmations in the Targeted R&D Program on Reading are to be conducted to ascertain the effectiveness of one or more specific instructional system components. Data must be accumulated which describe the operation of that component. To do otherwise would cripple decision making for it would create a situation in which data would confirm that something did or did not work but no data as to what that something is. This point demands continued monitoring during confirmation efforts.

One final point must be clear about these confirmation studies. In describing the general characteristics of a proposed component a mention was made of needed measuring procedures. Those measures either assess: (1) the component-relevant entry and terminal behaviors and knowledge of the learner; or (2) serve as screening measures for grouping learners. Those measures must be a part but not all of the measurement in a confirmation effort. In addition, the program criterion instrument (discussed in Chapter IV) for measuring functional reading competence must be employed. This latter measure will provide data helpful both in the acceptance, rejection, or return for further development of a specific component and for the system design activities to follow in Phase III.

Procedures for setting up independent confirmations involve program management, external consultants, an activity planning session, and a critical mass of developed instructional system components. The program managers must keep a close watch on the nature and number of components that are developed. This observation should be guided by the understanding that a complete instructional system is eventually to be designed and that the items being developed are potential bits and pieces for that system. The initiation of independent confirmation activities is a responsibility of program management. The decision to start is dependent upon the nature of the developed component(s) that first

become available. One component may be such a small piece of a clearly delimited larger system with at least logical interdependencies that it is unlikely to produce without some other components. Another component may have been created to develop a much larger isolable set of the functional reading criterion behaviors. In the first of these situations a confirmation test would be unprofitable. In the second it should be run.

Program management ought not to operate alone in this decision. The recommendations for program management (See Chapter VII) call for consultants whose substantive expertise can and should be used in this decision. The program management decision is not one of shall we or shall we not do a specific independent confirmation? Rather, has there been sufficient development to warrant starting confirmation planning?

An affirmative response sets into operation the assembly of a planning team. That group's purpose is the specification of a request for proposals for the anticipated work. Its first task is the examination of the developed components to affirm the program management's decision. Given a negative response to the state of development, this group should be disbanded. Potential members for this group should know of this possibility in advance of their acceptance of membership. Given affirmation of the program management decision, the planning group must specify the details of a confirmation test to be developed and circulated. This deliberation must take into account the nature of the component and the information needs set down in the criteria of communicability, effectiveness, robustness, and economic feasibility. Their planning efforts must set the decision points for program management. That is, it must state the variables and nature of data which are to be generated in the confirmation tests AND the criteria that must be reached to decide that the component should be forwarded as a candidate for instructional system design. Care must be taken to avoid biasing results of confirmation studies by the established decision standards.

Once a component has been the subject of an independent confirmation study three possibilities exist. If the generated data satisfy the decision standards, it becomes a candadite for instructional system design. Its existence as such is noted and information about it is accumulated with other components. Simultaneously, its existence is disseminated to individuals in the field through the program information system. This dissemination should be both focused and general; focused to investigators involved in the program and general to others who might possibly be interested. If the data fail to meet the decision standards, two possibilities exist. First, the component has weaknesses which make further efforts (at this time) unreasonable. And second, with some modifications it is logical that the decision standards might be met. The program management must use the

substantive and research expertise of available consultants to make this distinction. Components which are determined to be below acceptable standards but promising are to be cycled back for further development. Others are to be accumulated in the information system.

SUMMARY

The task of designing an instructional system using separately developed components is a complex one by itself. If it is confounded by the inclusion of ineffective components among its potential building blocks it is doomed to failure. To avoid this problem the planning team for the Targeted R&D Program on Reading has called for independent confirmation tests on developed instructional system components. These tests will determine the components' communicability, effectiveness, robustness and economic feasibility. They are independent tests in two senses. They are to be designed by individuals other than the component developer and they are to be conducted by still others. Instructional system components which perform satisfactorally in these tests will provide the basis for instructional system design efforts in Phase III.

CHAPTER XI

RECOMMENDATIONS FOR AND ABOUT THE FURTHER USE OF THE CONVERGENCE TECHNIQUE IN EDUCATION

At the close of its deliberations the planning team made three recommendations to the U.S. Office of Education in an interim report. One of those recommendations was, "The Convergence Technique should be used in future programatic efforts of the Office of Education." The discussion below details some of the problems encountered in this application of the Convergence Technique, suggests procedures which might be followed to avoid them in future applications, and the reasoning behind the recommendation.

Before presenting these points a brief review of the technique and the limitations of the present study are needed.

Efforts to apply systems analysis procedures to the planning and management of complex research and development programs in the bio-medical field led Louis M. Carrese and Carl G. Baker[1] to the development of the Convergence Technique. That

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[1]The statements made here about the Convergence Technique are the result of extensive interaction with Mr. Carrese. This interaction includes his participation with the first planning team for two days, direct personal correspondence, as co-participants on several symposia, and indirectly through his extensive conversations with three others who participated in planning team roles. The reader should recognize that credit for the procedure and its elements is due to Mr. Carrese despite the fact that each point is not specifically footnoted. A basic reference for this work is L. M. Carrese and C. G. Baker, "The Convergence Technique: A Method for the Planning and Programming of Research Efforts," Management Science 13:B-420-B-438; April 1967. This writer accepts responsibility for any errors in interpretation or description of the technique here.

procedure has been used in a number of research programs undertaken by the National Cancer Institute of the National Institutes of Health. Correspondence with scientific investigators of those programatic efforts has produced testimony regarding the facilitative eff of the technique in the bio-medical field.

The technique serves in two areas: first, in the planning that is done both initially and during a programatic effort which encompasses numerous research projects to be conducted over time; and second, in the management of the numerous activities through which those projects are carried out. Four points outline the technique as described by Carrese.

1. Initial program plans are drawn up by a small interdisciplinary team which meets for an extensive period to delineate:
   a. The goal to be achieved by the program.
   b. The subobjectives that must be met to achieve that goal.
   c. The sequence in which those subobjectives logically move to the goal.
   d. The criteria that must be met to determine that any subobjective has been accomplished.
   e. The research and/or development that must be completed to achieve each subobjective.
2. A chart which displays the five elements listed in number 1 above.
3. The use of that Convergence Chart by program managers for decisions on:
   a. Specific research projects to be undertaken.
   b. Movement to a next phase.
4. Modification of the program plan and chart on the basis of information generated as the research program progresses.

The project reported on in this document was the first application of the Convergence Tehcnique outside of the bio-medical field. Its purpose was two fold: first, the development of a research program plan to guide the U.S. Office of Education's efforts on reading; and second, to examine the feasibility of the technique for other education applications. This report cannot be interpreted as a thorough evaluation of the Convergence Technique as it has involved only the planning aspects of the technique.

This project had an inauspicious start. The first planning team convened under it failed to produce a convergence chart. That failure cannot in retrospect be attributed to the technique. Decisions were made about personnel for the planning team by the project director and project officer of the U.S. Office of Education which directly contributed to that failure. The individuals selected were highly competent persons who turned out to be inappropriate for the task. This recognition cannot be interpreted

as a reflection on the individuals involved. They are all outstanding individuals who worked diligently as members of the planning team.[2]

A post hoc examination of the output of the efforts of this first planning team led to the decision to conduct a definition effort and then to constitute a second planning team. The program plan proposed on earlier pages of this document is the result of these efforts. The experience in developing it has led the second planning team to strongly recommend the Convergence Technique for other programatic efforts. The facilitation of program planning by the technique is a marked improvement over other planning strategies experienced by these participants.

Before going further with this recommendation it is important to look at the nature of these other program planning strategies. They can be described on two dimensions: the number and kinds of persons involved, and the time schedule devoted to the planning effort.

Some planning situations are done on an individual basis while others involve large numbers of specialists. If the problem is one which requires information from many disciplines, the individually set plans are questionable. If a large group is involved, two problems exist. First, specialists from the same discipline often view the same phenomenon differently and infrequently relinquish their view to the "competition." If each member of the large group represents a different discipline a considerable amount of the discussion is of a getting-to-know-you sort and not productive of plans.

The time dimension varies from relatively short planning efforts to continued daily interaction over weeks. Brief efforts may be of two sorts, either all day for two or three days or a few hours a week for several weeks. Neither of these are very productive. Typically items which are hard to resolve are pushed aside because of the press of time. And sometimes, a next session proceeds as if those difficult items are resolved. Implementation of plans made this way readily displays their inadequacy. Long term sessions avoid the dodging of important problems or conceptual misunderstandings. However, because of their cost they are seldom feasible without outside support.

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[2]This problem and suggested solutions are discussed later in this chapter. It is raised here to recognize it as a part of the history of this project AND to state clearly that no personal or professional criticism of the participants of that first planning team is intended or warranted.

Most education planning sessions seem to involve sizeable groups for short periods of time. The experience of the planning team members in such sessions is not positive. The Convergence Technique planning session was a striking contrast. Long periods of time were devoted by a small group each of whom represented a different specialty. Because of the size of the group the time needed to learn each other's vocabulary was reduced to a minimum. Because of the duration of the effort points not resolved had frequent opportunity to resurface most of these were either resolved or spotlighted for further work.

The procedures of Convergence Technique planning facilitate the work of the group still further. Those procedures, operated by the systems analyst member of the team, include: (1) the specification of the program objective; (2) setting the general structure of the program plan; (3) detailing the subobjectives required in the general structure; (4) stating criteria for the achievement of each subobjective; (5) detailing, where possible, specific studies to be conducted to accomplish each subobjective. This in effect is a cyclic treatment of the plan, adding detail with each cycle. As these cycles build the plan up, a point overlooked or not clearly specified at one spot is pointed up by development of another.

The cost of planning, using this format, is greater than the cost of short term sessions. Because of their experiences with it, the second planning team believes the expenditure of such larger sums to be more economically efficient in the long run.

The problems encountered in this application of the Convergence Technique are of two sorts. The first, already alluded to, is the selection of a planning team. The second problem centered around the advance definition of the problem to be attached. Neither of these problems seem to exist in the bio-medical field applications, although conversations with Carrese indicated that some minor planning team personnel problems have been encountered. As the project progressed the nature of these problems became clearer and logical solutions for them were identified.

The selection of planning team personnel according to the proposal for this project was a mutual responsibility of the project director and the project officer in the USOE Bureau of Research For this task they had Carrese's statement that the planning team should consist of "...five persons whenever practicable." That those persons should show "...a balance between generalists and specialists," and that three

> ...kinds of individual talents are essential: (a) one person who has a general, comprehensive knowledge of the broad area of research and major scientific disciplines in which the substance of the program to be planned is included; (b) one person with specialized

> knowledge of and experience in the conduct of research in the particular area to be planned; and (c) one person with general systems analysis knowledge and direct experience in the use of the technique.[3]

This core membership, according to Carrese, should be augmented by specialists in other disciplines that contribute knowledge about the problem on which the planning focuses.

In the identification of participants for the first planning team, a decision was made to look for individuals who would fit one of the categories specified by Carrese and who had also demonstrated interest in research on reading. In retrospect that appears to have been a mistake. As a result of that decision several persons in the first planning team could be considered reading specialists, specialists whose views of reading were different. This had two drawbacks. First, it tended to focus the group's attention on the research problem-modeling reading-and away from the need to define a program of activities which would facilitate solving that (and other) problems. Second, when two persons view the same phenomenon and generate different understandings of it, those differences have two possible sources, personal insights and/or vantage point differences. Neither of these differences are data based and consequently they are extremely hard to weigh for relative merit. As a result one specialist seldom finds it an easy and quick task to convert another to his frame of reference. When a third party is involved who is not a specialist in that area still another set of problems arises. This third party must accept one specialist and reject the other or become expert in the area himself. Neither of these alternatives is conducive to planning.

Carrese's third category of planning team participants also presents a problem. The number of persons with general systems analysis knowledge who have had "...direct experience in the use of the planning technique." are limited. In fact, at the time this effort was initiated only Carrese himself qualified and he was unavailable. To compensate, an individual with some systems background was identified and this person was asked to consult with Carrese about the technique and its inherent procedures. Again, the project director and USOE project officer made a selection error. The systems analysis experience needed for the Convergence Technique is that gained through work on broad management problems. That was not apparent to the personnel selectors at the time the first team was constituted. Again, this reflection is not a criticism of the individual who was involved. He was an accomplished person who worked diligently with the group. It is now clear that the systems analysis role on the planning team must be filled by

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[3] Ibid. p. B-424-B-426.

a person with broad experience involving management problems. Ideally, the systems analyst should also have general knowledge of science and engineering processes.

Two other problems were observed in the selection of planning team members, neither of which was apparent in the biomedical applications of the Convergence Technique. Those applications were made in an institution which has a working laboratory staffed with experts in relevant fields. A planning team there could be staffed by reassigning people who are readily available. Application of the Convergence Technique to educational problems is a different situation. The needed personnel are scattered among different institutions. This causes difficulties of knowing what a person is doing and of securing backup personnel in case of emergencies. Both of these problems were encountered in this application. Specialists can be identified through the work they have done. But, this is not up to date information. A person's publications due to lag time in printing and in work schedules may not reflect what he is currently attending to. If a team is to be composed of people who normally work at different places, the planning team selectors must visit with them to determine their current concentrations.

The backup problem is of a different sort. Decisions in advance of selecting members of the first planning team called for the inclusion of one person who had done research in the neurophysiology of learning and communication. One individual was identified whose background and accomplishment was more than acceptable to the USOE and the project director. He was contacted and agreed to participate. Three days before the planning team was to convene, his physician told him he could not participate for reasons of health. Because of a lack of backup personnel, the planning team did not have constant input from this area.

The final problem encountered in this application is one of problem specification. The problem statement in the proposal for this Convergence Technique application was not sufficient. It recognized that a reading problem exists and that a systematic, coordinated, and cummulative attack on that problem was needed. But, like statements made by many in the field, the elements of that problem were not described.

Analysis of the experience with this Convergence Technique application has led to three general recommendations which should resolve these problems if followed in other applications. These recommendations are:

1. The lead time between the decision to apply the Convergence Technique and the conduct of a planning session must approximate one year.
2. Early in that year one or more preliminary sessions should be held involving personnel from which a planning team will be selected.

3. Files should be kept within the U.S. Office of Education which identify persons with the systems analysis knowledge and experience needed for future applications of the technique.

The lead time recommendation has two bases. First, it would make possible the preliminary activities suggested in recommendation number two. Second, it will increase the roster of potential planning team members. Many people who should be considered as participants in a planning team have schedules which commit their time for months into the future. A request which involves full time work for four to six weeks is beyond consideration on their part unless there is adequate lead time for them to arrange their schedules.

The recommendation that preliminary sessions be held has two underlying points. First, there is as indicated above a need to detail the nature of the problem. Second, there is a need to observe potential team members both to gain a better perspective on their potential contribution and to observe their interaction with the others that might be involved. These preliminary sessions could be scheduled for one week for the purpose of defining the problem on which the Convergence Technique is to be applied. Several persons for each of the roles in the planning team could be invited to attend. The session should be structured so that the large group meets together at the start and then is divided into smaller work groups during the week. The composition of the smaller groups should be varied to permit observation of the interaction of various subsets of the total group. Three additional products might result from these preliminary sessions. If time permits the group can attempt to specify the program objective. Based upon the observations, backup personnel can be identified in case the selected planning team members have to withdraw. Finally, the individuals conducting the session can identify in advance some terms basic to the problem which need to be defined before the planning team assembles.

The third recommendation focuses on available systems analysts. It is clear that the technique requires an individual with this background. When the planning team starts its work, this person must assume the role of team leader. He directs the work of the group as they set an objective and structure the program plan. His ability to conceptualize a system and by adroit questioning to elicit the details of that system from the substantive specialists on the team is critical to the success of the effort. The identification of persons with these skills is necessary if the Convergence Technique is to be successfully applied to other educational problems. The Office of Education should start immediately to identify individuals with this background and ability. Their identification should be backed up with continually up dated files that permit the selection of appropriate personnel for subsequent efforts.

One other role must be highlighted, the representative of the agency from which the major program support is to come. This individual must participate in all planning sessions related to and involved in the Convergence Technique application. This includes the deliberations which result in the decision to apply the Convergence Technique, preliminary planning sessions, the selection of planning team members, the planning team sessions, and the deliberations involved in implementing program plans. His role is one of interpretation of the intentions of the funding agency to the planners and vice versa. It is impossible to put all of either party's intentions on paper in a manner which guarantees communication. Thus, this role must be maintained. The incumbent in that role must be carefully chosen. He cannot enter the deliberations with a set program in mind nor can he fail to be explicit in interpreting the intentions of the funding agency.

The recognition of the systems analyst and the funding agency representative should not be interpreted as denigration of the contributions of the other planning team members. These two generalists could not devise a plan without the expert knowledge of the problem held by the substantive specialists.

SUMMARY

The planning facilitated by the Convergence Technique has led to recommendations that the technique be used in the U.S. Office of Education when they contemplate undertaking other programatic efforts. To avoid some of the difficulties encountered in this application three recommendations are made. First, lead time of approximately one year should be allowed between the decision to plan a program and the scheduled planning team sessions. Second, preliminary planning sessions of approximately one week in duration should be scheduled to delineate the problem and identify planning team personnel. Third, the Office of Education should set up personnel files on individuals who have the systems analysis knowledge and background necessary for the conduct of a planning team.

APPENDICES

APPENDIX A

A CHRONOLOGY OF EVENTS LEADING TO, DURING, AND RELATED TO PROJECT NUMBER 8-0737

The following items indicate events and activities that took place prior to and during this project. Some of them list people contacted and consulted with in program planning or in the search for planning team members. Numerous other telephone and mail contacts were made but failed to get trapped in the project's record keeping system. Some of the reported items identify diffusion activities associated with the project including symposia, writings and speeches made by persons involved, and articles written by others about this project and the Convergence Technique.

Mid-October 1967: Howard Hjelm, then Director of The Division of Elementary and Secondary Research, initiated an informal staff study of research on reading. The study was expected to determine the desirability of establishing a Bureau of Research (BR) priority on basic research on the reading process, as distinguished from reading instruction.

By December 1, 1967: Four drafts of a position paper had been prepared, circulated, and critiqued. The personnel involved in drafting the paper were: Howard Hjelm, James Moss, George Olshin, Chet Avery, Robert Beezer, and Monte Penney. Hendrik Gideonse, Lee Burchinal, Al Storm, Edward G. Summers, James Colmen, Richard Adams, David Yarington, and Jeanne Chall reacted to various drafts.

Also by December 1, 1967: BR and Bureau for Education of the Handicapped (BEH) had agreed that a joint priority on the reading process should be established. BR set aside $50,000 and BEH ear-marked $10,000 for the planning phase of a multi-project program in this area. Subsequent research support from BEH, it was agreed, would be "contingent upon the development of projects that are appropriate for funding under legislation for the education of the handicapped."

December 2, 1967: Monte Penney addressed about 300 persons at the National Reading Conference on "The Developing Climate for Reading Research: Program VS Projects." The Paper, co-authored by Richard B. Adams, appeared in the 17th yearbook of the National Reading Conference.

On December 22, 1967: Monte Penney made contact with Louis M. Carrese, Acting Associate Director for Program at the National Cancer Institute--and originator of the Convergence Technique.

January 10, 1968: A discussion took place between Howard Hjelm and Arthur Foshay on USOE interest in research on the reading process.

January 17-19, 1968: A discussion involving Howard Hjelm and Ira Aaron, head of the Reading Department at the University of Georgia was held again focused on research programing in reading.

February 3, 1968: Howard Hjelm and Monte Penney met with Ralph Staiger, Executive Secretary of the International Reading Association (IRA). Dr. Staiger was supportive of the idea of a program of research on the reading process and of the use of the Convergence Technque.

March 6, 1968: Discussions were held involving Howard Hjelm, Nicholas Fattu (on leave from Indiana University to the Office of Education) James Miller, and Monte Penney. The decision to employ the Convergence Technique had been reached by this time. Discussion centered on the implementation of a planning project and on the membership of a planning team.

April 18, 1968: Monte Penney discussed the proposed program of research with Mark Ozer, a neurologist at Children's Hospital.

April 22, 1968: Howard Hjelm, Glenn Boerrigter, Mike Bohleber, Philip Thienel, and Monte Penney discussed a draft proposal for a planning project. All agreed that plans were sufficiently developed to warrant contacting a potential contractor on a sole-source basis, and to consider actively the choice of planning team members.

April 24, 1968: Howard Hjelm secured the interest of William J. Gephart, Director of Research Services for Phi Delta Kappa, Inc., in conducting the planning project. Gephart whose main interest is "research on research," felt that an application of the Convergence Technique to an educational research problem would be a valuable effort for two reasons: (1) potential contribution to understanding of reading; and (2) assessment of the feasibility of the Convergence Technique to other programatic efforts in education.

April 25-26, 1968: Howard Hjelm and Monte Penney, while at the IRA convention in Boston, held discussions with Fred B. Davis, Theodore Clymer, J. Wesley Schneyer, and John R. Bormuth. All of these men were supportive of the proposed programmatic effort.

May 6, 1968: Howard Hjelm wrote to Harry Singer, Chairman of the IRA research committee, to invite his interest in the program.

May 10, 1968: William Gephart agreed to conduct the planning project and submitted proposal No. 8-0737.

May 10 - July 30, 1968: Gephart, Penney, and others contacted the following people regarding membership in the planning team:

**Donald E. P. Smith	Theodore Clymer
**John Ertl	Tomas Bever
**Nicholas Fattu	Russell P. Kropp
Ralph Staiger	Asahel Woodruff
Jeanne Chall	James Raths
Harry Singer	Richard Turner
*John B. Carroll	Ira Aaron
Mark N. Ozer	Lester McLane
Martin Kling	Gene Glass
**Willavene Wolf	***Robert Remstad
Ronald Tikofsky	Joanna Williams
*Leo Fay	Eric Gardner
**Edward G. Summers	David Krathwohl
Louis Jacobs	Benjamin Bloom
Noam Chomsky	C. M. Lindvall
Thomas G. R. Bower	Arthur Lumsdaine
*John C. Lilly	Eleanor Gibson

* - Served as consultants to the first planning team
** - Served as members of the first planning team
*** - Substituted for N. Fattu for first two weeks of planning team session.

June 15, 1968: A $61,376 planning contract, 8-0737, was awarded to Phi Delta Kappa, Inc. with, William J. Gephart as principal investigator. By Oct. 15, 1968, Gephart and his planning team are expected to produce a Convergence Chart for the Research Program on the Reading Process.

August 1, 1968: A U.S.O.E. press release written by Victor Terranova announced the Phi Delta Kappa Contract Award and stated that USOE was "launching a major program of basic research on the reading process." The release briefly explained the Convergence Technique, and named the Planning Team members.

August 12 - Sept. 20, 1968: The first planning team met for six consecutive weeks in Bloomington, Indiana. Members of the team and their respective roles were:

Educational generalist	- Nick Fattu; Robert Remstad
Reading Specialist	- Edward G. Summers
Systems Analyst	- John P. Ertl
Psychologist	- Donald E. P. Smith
Neurophysiologist	- John C. Lilly (Illness prevented Dr. Lilly's full-time participation; he served as a consultant for 1-1/2 days.)
Research Management	- Monte Penney

Willavene Wolf served as research associate; research assistants were Joan Hawley and Sister Ione Taylor. John B. Carroll, Thomas Sebeok, Kenneth Goodman, Leo Fay, and John C. Lilly served as consultants.

This planning team specified a final goal for the Research Program on the Reading Process: "Proven ability to educate 95% of all ten-year-old school children to a criterion level of literate behavior." Further, the group identified a number of key philosophical problems which need resolution, particularly the problem of definition of the term "reading."

Other products of the sessions were:

(1) a block diagram of a Convergence Chart;
(2) a tentative definition of reading;
(3) a revision of Kenneth Goodman's model of the reading process; and
(4) specifications for conducting a literature search, should one become necessary.

The secondary goal of the planning project was to assess the applicability of the Convergence Technique to problems in educational research. The initial planning team's formulation and interaction yielded a large number of "do's and don't's" for future practitioners of the Technique and a strong indication that the Technique is both replicable and useful in educational research planning.

The usefulness of a definitional technique formulated by Henry Cady (Ohio State University) is also indicated by work to date.

August 22, 1968: Washington Daily News published an article by Alex Bilanow which was similar to 8/1/68 USOE release, but with the inclusion of reference to previous research efforts.

August 23, 1968: A Behavioral Science Newsletter article stressed theory-building aspects of the proposed new program.

September 1968: Phi Delta Kappa News Notes and Quotes reprinted the 8/1/68 USOE news release.

September 1968: A.E.R.A. Educational Researcher reprinted the 8/1/68 USOE news release.

September 30, 1968: A National Observer article on reading mentioned this program.

October 1968: AERA Educational Researcher printed James Welsh's extended discussion of the new program to explain the Convergence Technique.

October 21, 1968: William Gephart presented a review of the Project No. 8-0737 activity to the Secretary's Advisory Committee on Dyslexia. Louis Carrese attended that session and responded to questions after Gephart's presentation.

October 21, 1968: William Gephart briefed USOE staff regarding the status of the planning project. Persons present were: Norman J. Boyan, David Pollen, Tom Moorefield, James Moss, and Monte Penney.

December 13, 1968: The contract for project 8-0737 was extended through January 15, 1969 to complete the reporting task.

January 6, 1969: Louis Carrese and William Gephart presented respectively a discussion of the Convergence Technique and a progress report on the planning project to about 25 Federal research managers convened by the Under Secretary of H.E.W. A list of invitees is in file 8-0737.

January 31, 1969: At the request of Miss Arlene Jones, a staff member for the Secretary's National Advisory Committee on Dyslexia and Related Reading Disorders, Penney prepared a statement describing the Research Program on the Reading Process. The statement stressed the hopes for interagency collaboration and the availability of the Convergence Chart to any agency or institution that wants to use it. In addition the statement commits BR to providing funds for an annual up-dating of the chart.

February 7, 1969: AERA Symposium on the Convergence Technique application. Papers by (1) Hjelm, Storm, and Penney, (2) Carrese, and (3) Gephart were read to about 45 persons. These papers were submitted and expected to be printed in Fall, 1969 Reading Research Quarterly.

February 17, 1969: U.S. News and World Report briefly mentioned the planning project.

March 11, 1969: The contract for project 8-0737 was extended through November 30, 1969 to provide for further work on a definition of reading and a second planning team effort.

April 1969: Copies of Gephart's chapter on the definition of reading were mailed to 50 persons with the promise of a $25.00 honorarium for their critical reactions. An additional 100 persons were sent copies of the chapter without the promise of an honorarium. Persons names in the list represent 11 major disciplines; eight interest groups, (e.g. advisory committees, industry, non-profit corporations, Federal agencies); four foreign countries; and 30 of the United States. Their names and affiliations are listed in the file of project 8-0737. Responses received by May 26, 1969 filled 48 pages.

April 27, 1969: An article by Judith Randall and James Welsh appearing in This Week Magazine provided an excellent short discussion of the program.

May 1969: The first PREP monographs were released by the Research Utilization Branch. The Research Program on the Reading Process is mentioned on page 2.

May 1969: Dr. Norman J. Boyan, Robert Hochstein, and Monte Penney prepared a statement on reading research, beginning with a discussion of the new program, for insertion in the Congressional Record by Congressman Michaels of Illinois.

May 2, 1969: An IRA Symposium on the new program was presented. Papers by (1) Penney and Hjelm, and (2) Gephart were read to about 65 persons. The papers were printed by AERA Journal. (During the IRA convention, Penney held discussions of the new program with 35 active investigators).

May 10, 1969: Norman Boyan briefly described the Research Program on the Reading Process at the meeting of the National Research Council's Committee on Basic Research in Education.

May 26-28, 1969: The following people met in Bloomington to develop an operational definition of reading behavior: Alton Raygor, Wendell Weaver, John Bormuth, Helen Robinson, Sara Lundsteen, Edward Summers, William Gephart, and Monte Penney. The group developed the following statement for the use of the next planning team:

> "Reading behaviors are covert responses to written verable language. Those covert responses are indicated by overt performances which could not have occurred without the covert responses to the written verbal language."

In addition, this group proposed that the goal statement explicitly include a requirement for delineating a reading performance criterion at age levels 9, 13, 17, and adult.

May 27, 1969: USOE Press Release written by Jane Stewart Denton presented practical advice from Julia Haven for parents of children who are learning to read. This article ended with a good description of the new research program.

June 24, 1969: Monte Penney sent a collection of documents on the research program to Michael O'Keefe (Office of the Assistant Secretary for Planning and Evaluation) at Mr. O'Keefe's request.

June 20 - August 15, 1969: Gephart, Penney, and others contacted the following people regarding membership of the second planning team:

Maitland Baldwin	Kenneth Goodman
Frank Benson	Doris Gunderson
Arthur Benton	Harry H. Harmon
Edgar Bering	*James Laffey
Enoch Calloway, III	Eric Lenneberg
Louise Carrese	David McConnell
James Caveness	David McNeill
Richard Chase	Brenda Milner
Susan Ervin-Tripp	*James Ross
**Nicholas Fattu	**Roger Sisson
Karl Frank	**Walter Stolz
M. G. F. Fuortes	**Ed Summers
Norman Geschwind	Delos Wickens

* - Served as consultants to the second planning team
** - Served as members of the second planning team

July 7, 1969: Monte Penney spoke with Harvey Marron regarding early insertion of the Gephart report into the ERIC system. Mr. Marron felt sure that the report can be ready for sale through ERIC within 2 months of the date it is approved.

July 15, 1969: Penney briefed Dr. Jerome Hellman, National Executive Editor of Brunner/Mazel publishers, on progress in the planning project. Hellman is developing an annual volume on progress in reading. He would like to have a chapter on the new R&D Program on Reading.

July 17, 1969: Penney briefed Dr. John Carroll on progress in the planning project.

July 18, 1969: Commissioner Allen held a small staff meeting to discuss his intention to launch a major program aimed at eliminating reading deficiencies. Present were Dr. Allen, Dr. Gallagher, Dr. Hjelm, Dr. Davies, Mr. Leroy Goodman, Dr. John Manning, Dr. Kay Lumley, Mr. Michael O'Keefe, and Mr. Monte Penney.

July 22, 1969: Penney made an initial contact with Dr. William Glasser, Psychiatrist, and author of Reality Therapy and Schools Without Failure.

July 24, 1969: Penney sent basic descriptive material on the Gephart project to Mr. John Robb, Foundation for Improvement in Research and Education.

August 29, 1969: Glenn Boerrigter, Tom Moorefield, John Egermier and Monte Penney made a site visit to Gephart's project. Everything was ready for the second planning session.

September 9, 1969: A conversation about the program was held with Dr. Richard Dershimer of A.E.R.A.

September 11, 1969: Penney transmitted a briefing memorandum on the new program to Dr. Pollen. Dr. Pollen forwarded the memorandum to Dr. Gallagher.

Sept. 15 - Oct. 15, 1969: The second planning team was in session at Phi Delta Kappa headquarters. This team included: William Gephart, Project Director; Nicholas Fattu, educational psychology and research design; Edward Summers, reading; Walter Stolz, psycholinguistics; Roger Sisson, systems analysis; and Monte Penney, research management. This group developed the initial Program Plan. James Laffey, reading research, and James Ross were called in as consultants during this period.

October 20, 1969: William Gephart briefed USOE staff members, including Dr. Gallagher, Dr. Pollen, and Dr. Green, on the program plan.

November, 1969: The News, Notes and Quotes Newsletter of Phi Delta Kappa published a picture of the planning team at work.

November 4, 1969: Penney spoke to Dr. Richard Turner, new editor of AERJ. Penney agreed to send Dr. Turner a manuscript on the new program by early December.

November 18, 1969: Mail contact was made with Dr. Edmund B. Coleman, University of Texas at El Paso regarding the research program and Coleman's work on reading.

November 18, 1969: Penney briefed Dr. Beszinick, University of Miami research coordinator, on the new program. Beszinick agreed to brief Dr. Emmet Betts upon his return to Miami.

On November 19, 1969 and November 24, 1969, respectively, Ann Kohankie, USOE Staff Member phoned the regional printing offices in Chicago and in D.C. (Navy Yard) to get estimates of cost and turn-around time on printing a 150 page monograph based on Gephart's work. About $1,500 would be required for 1,000 copies; the job can be done in 3-4 weeks.

November 26, 1969: Penney briefed Dr. Joseph Margolin, Director, Educational Policy Group, George Washington University, on the new program.

November 26, 1969: Penney sent 15 copies of Gephart's October 20 briefing paper to IRA Executive Secretary, Ralph Staiger. Staiger sent these to the IRA Board members and asked for 15 more for the research committee. These were mailed December 2, 1969.

November 28, 1969: Penney, Moorefield, Boerrigter, and Hochstein agreed to name the new program "The Targeted Research and Development Program on Reading."

November 28, 1969: Penney submitted an article entitled "An Introduction to the Convergence Technique" to Educational Researcher, newsletter of AERA.

December 4-5, 1969: Monte Penney and William Gephart participated in the 19th Annual National Reading Conference in Atlanta, Georgia. Dr. Gephart read a paper which presents the program plan.

Informal contacts were made with Drs. George Spache, Carl Lefevre, Ira Aaron, Wendell Weaver, Alton Raygor, Ed Coleman, John Bormuth, Dave Wark, Dave Yarington, Al Kingston, Harry Singer, and Martin Kling. Feedback on the Gephart presentation was very positive. Ed Coleman is attempting to start an AERA Special Interest Group on Reading. Gephart and Penney reinforced him liberally and agreed to help.

APPENDIX B

DEFINITION: A BASIC PROBLEM IN PLANNING A RESEARCH PROGRAM ON READING

> The range of definitions and descriptions of reading is great, as this chapter has attempted to demonstrate. To some authors, reading is responding orally to printed symbols. At the other end of the continuum, reading is viewed as resulting in a changed view of life which produces corresponding changes in behavior.[1]
>
> In some ways the exploration and evaluation (of definitions and concepts of reading) are unsatisfying, because so much remains to be learned about what reading is and how the process functions. Much of what we need to know must await further developments in basic and applied research.[2]
>
> The lack of definitive information on all factors should not obscure one fact of enormous importance to teachers and educators: our definition of reading and outcomes we hold for the reading program have immediate and important implications for how we teach reading and what we teach in it. There is no question more important to ask than: "What is reading?"[3]

In these statements Clymer describes both the focus of "The Application of the Convergence Technique to Basic Studies of Reading,"[4] and the major problem encountered in the course of that project. An application of the Convergence Technique is an attempt to organize a research program consisting of those "...further developments in basic and applied research." As the work in it progressed, time and time again the question, "What is reading?" was raised. In fact it was raised so often that the project's

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[1]Theodore Clymer, "What is 'Reading'?: Some Current Concepts," Chapter I in Innovation and Change in Reading Instruction: NSSE Yearbook, Part II Chicago: University of Chicago Press, 1968. p. 27.

[2]Ibid. p. 28.

[3]Ibid. p. 29.

[4]William J. Gephart, "The Application of the Convergence Technique to Basic Studies of Reading." U.S.O.E. Cooperative Research Project No. 8-0737. 1968.

procedures were altered to make a direct attack on the problem, the "...formulation of a comprehensive and staisfactory definition of reading..."[5]

A Convergence Technique application involves, among other things, an interdisciplinary planning team which meets for several weeks.[6] During this period they state a goal, determine the subgoals that must be achieved to meet it, outline the sequence in which the subgoals logically fit, state the criteria which must be met to conclude that each subgoal has been achieved, and list the individual research projects that are necessitated by each of the subgoals. A definition of reading is of equal importance in such an effort as Clymer indicates it is to teaching.

As the reading planning team worked it was not uncommon for someone to ask, "What is the definition of reading?" To such a query the reading specialists in the group responded, "The definition depends upon your perspective or interest in reading." This statement would then be followed by comments similar to those documented by Clymer. Some people are interested in reading as a perceptual task. Their definition is structured around the perceptual process. Others see reading as one way in which meaning can be transmitted from person to person. Their definitions reflect that semantic transfer focus. Those involved in teaching beginning readers may focus on the development of certain visual and auditory language processing skills. Reading is sometimes defined by these people as the generation of such skills.

Each of the definitions alluded to above is a legitimate effort to provide boundaries that have clarity for a given perspective or interest in reading. However, none of them are broad enough to encompass all of the aspects of reading cited by Clymer as he states,

> The difficulty in formulating a comprehensive and satisfying definition of reading is also apparent. The areas of perception, psychology of learning, linguistics, social psychology, and language learning are a few of the fields contributing to an understanding of the reading process and the reading program.[7]

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[5]Clymer, Op. cit. p. 8.

[6]Louis Carrese, "The Convergence Technique: A Method for Planning and Programming of Research Efforts." Management Science. 13:420-38; April, 1967.

[7]Clymer, Op. cit. p. 8.

In retrospect, two alternatives seemed open to the planning team. They could select and employ a number of definitions using them at different points in the research program. Or, they could try to develop a comprehensive definition on which to base the research program planning. The first alternative was not given much consideration. The planning team seemed to accept the assumption that a comprehensive research program had to be based on a comprehensive definition. Over a third of the planning team's work time was devoted to delineation of the material that might constitute such a definition.

At the conclusion of the planning session a Convergence Chart had not been developed. The team did produce: a goal statement; a block diagram of the general activities believed necessary to achieve that goal; details for a tentative definition of reading; a hypothetical model of the reading process; and specificats for a literature search, evaluation, and synthesis needed as the basis for the research program. After the planning team departed the project director wrote a reading definition statement and prepared to make a final report on the project.

As the original contract drew to a close, discussions with representatives of the U.S. Office of Education led to a more direct focus on the definition of reading. As a result of those discussions procedures were initiated to: (1) solicit critiques of the definition; and (2) synthesize those critiques through an invitational reading definition conference involving six noted researchers in the field of reading. The remainder of this report describes that work. It will be presented under the headings:

Reading behaviors: an operational definition.

A tentative definition of reading.

Summary of the critiques of the tentative definition of reading.

Before presenting the material on reading behaviors the fact that a difference exists between "reading" and "reading behaviors" should be made clear to the reader. Failure to do so would risk the danger Robinson identified in an attempt to explain why less than adequate definitions of reading exist. She indicates that there has been a failure to distinguish clearly among: (a) the processes required to read; (b) the skills and abilities used in reading; and (c) the procedures used to teach reading.[8]

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[8]Helen M. Robinson, "The Major Aspects of Reading." In Reading: Seventy-Five Years of Progress. H. Allen Robinson, (Ed.) Chicago: University of Chicago Press, 1966. pp. 22-3.

Before the invitational reading definition conference, the six participants were given a copy of "A Tentative Definition and Model of Reading," and verbatim copies of the solicited critiques. After studying those materials they made two recommendations. First, after some revisions, the tentative definition of reading should be made available as a part of the report on this project. Second, a definition of "reading behaviors" should be substituted for the definition of "reading" as the basis for research planning in the application of the Convergence Technique.

The paper defining "reading" uses an analysis of the usage of the term and six definitional approaches. Although the definition conference participants indicated that this multiple definition approach aided their thinking about the task facing them, they recognized in it the criticism stated by Clymer. "Much that we need to know (to define reading) must await further developments in basic and applied research."[9] In lieu of the unknown the tentative definition of reading uses other constructs about which there is still much that is unknown. Kerlinger calls such definitions "constitutive definitions," that is, "...a definition that defines a construct with other constructs."[10] In the opinion of the definition conference participants a research program should be based upon an "operational definition," that is, "...a definition that assigns meaning to a construct or variable by specifying the activities or 'operations' necessary to measure the construct or variable."[11]

READING BEHAVIORS: AN OPERATIONAL DEFINITION

After some discussion the participants agreed on the following definition.

READING BEHAVIORS are covert responses (1) (2) to verbal written (4) (5) language (3). These covert responses are indicated (7) by overt performance (6) which could not have occurred without (8) the covert responses to the written language.

In their discussion eight key elements of that definition were elaborated on. Those elements have been set off in the definition

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[9] Op. cit. p. 28.

[10] Fred N. Kerlinger, Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, Inc., 1964. p. 34.

[11] Ibid. p. 34.

by underlining and numbered. Those elements are defined below.

(1) Covert Responses. Acts or actions to a motive force that is hidden from observation. Physiological and neurological processing that is unobservable given current methodology is included as are the mental events and patterns of events that presumably mediate overt behaviors.
(2) Plurality of covert responses. In an effort to be explicit emphasis is given to the idea that a variety of responses exist. This plurality is further emphasized through the pluralization of the term "reading behaviors."
(3) Language. The words and the methods of combining them used and understood by a considerable community and established by long usage.
(4) Verbal language. This adjective is included to emphasize that the language in question is one of words. By including this adjective artistic, musical, and number languages are excluded from the definition.
(5) Written verbal language. Verbal language can be used in either of two forms, visual or oral. The inclusion of the adjective "written" is intended to include language that is recorded in visual form and to exclude language that is oral.
(6) Overt performance. This term includes actions or activities that are observable with or without instrumentation.
(7) Indicated. A logical connection between the overt performance and the covert response is implied through the verb "indicated." The definition implies through this term that the observation of the overt performance shall be taken as evidence of the existence of covert responses.
(8) Could not have happened without. This bit of redundancy is included and emphasized to highlight the need for scientifically sound empirical evaluation which establishes that the overt performance is related to and/or caused by reading and not other factors.

This definition merges the constitutive and operational. Its first sentence is the explanation of one construct, "reading behaviors," by a second, "covert responses." The second sentence, which is intended as a part of the definition, inserts overt performances, operations which can be observed and/or measured, and asserts that their observation shall be taken as indicators of the responses and thus of reading behaviors.

This mixture of definitions was affected knowingly by the reading definition conference participants. They were

simultaneously striving for a definition that had denotative strength as the basis for research and scientific utility for theory development. The importance of operationalism for research has been cited in many writings on the research process. Scriven says, "...there is only one standard for good definitions, and that is inter-user reliability in their use in a given verbal or empirical context..."[12] The best way to ensure high inter-user reliability is the use of directly observable and mechanically quantifiable elements in definition. A length of one foot fits these requirements. It can be directly observed and is easily quantified. One of the goals of reading research as posed by the reading definition conference participants is akin to developing standards like one foot for the field of reading. That is, reading research must: (1) identify those directly observable items, actions, or events that are correlates of the covert responses; (2) determine with scientific conclusiveness the dependence of the overt performance on the covert responses; and (3) develop valid scales for quantifying those overt performances.

A TENTATIVE DEFINITION OF READING

As indicated earlier a tentative definition of reading had been generated. Although it was not selected as the basic definition for the project, it is presented here for two reasons. First, the definition conference participants directly encouraged its presentation as a unique attempt. They were critical of it as a basis for a research program but commended it as an attempt to view reading from many vantage points. The second reason for its inclusion grows out of the definition they selected. Reading behaviors are an aspect of reading. Thus, the tentative definition provides a general background for considering the term the reading definition conference participants chose to concentrate on.

As indicated earlier the tentative definition of reading was generated from work done by the first Convergence Technique planning team. That group, concerned with the need for a basic definition on which to base the research program, examined a variety of definitions of the term "reading." In this effort they specified a number of items that should be included and encouraged the structuring of a definition that merged these items.

The tentative definition of reading presented below follows a format established by Cady in his effort to define

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[12]Michael Scriven, "The Philosophy of Science in Educational Research." Review of Educational Research 30:422-9; Dec. 1960.

"music education."[13] Examination of Cady's work highlights different approaches to definition that can be taken. Some will choose to define a complex term by describing what sort of thing it is. Others in defining the same term will ask, "What does it consist of?" Still others will define it in operational terms, "How does it work?" Still others will attempt to define by describing where the term fits with others with which it is normally associated, etc.

After examining Cady's work, the writer became convinced that a thorough definition must speak to all of these definitional approaches. To fail to do so results in an incomplete definition. Thus, the tentative definition is based on a synthesis of six definitional approaches.

Cady also suggests that a portion of the meaning of a complex term can be obtained by examination of the manner in which the term is used. Five categories of usage are examined in his work on music education. These same categories have been applied in the tentative definition presented below.

One final point should be emphasized before starting the definition. In the material which follows six segments are presented which, because of their nature, could be interpreted as independent attempts to define reading. That is not the intent. All of them are ways of presenting views of reading. THE definition is all of the views taken simultaneously. An analogy to this would be an effort to know what is included in a house you might wish to purchase. A front view gives some information about the house. Pictures taken from the other side and even inside are necessary for that comprehensive understanding. The house is not one of these pictures but an assembly of all of them.

TOWARD A DEFINITION OF READING

The methodological strategy for the definition of a complex topic displayed by Cady[14] suggests two points about the definition of a complex term.

1. A definition for a word or term that has both specific and general meaning in a field cannot be presented in a single sentence or brief paragraph.

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[13]Henry L. Cady, "Toward a Definition of Music Education." In A Conference on Research in Music Education. H. Cady (Ed.) Cooperative Research Project No. 6-1388. Columbus, Ohio: The Ohio State University Research Foundation. May, 1967.

[14]Ibid.

This assertion is based on the belief that a restricted number of words cannot convey enough meaning to provide an unambiguous definition.

2. The meaning of a term can be synthesized through:
   a. application of a variety of definitional techniques including:
      1) synonym and antonym definition
      2) ostensive definition
      3) comparative definition
      4) structural definition
      5) classificational definition
      6) operational definition
   b. an examination of the manner in which the term is used.

DEFINITIONAL TECHNIQUES APPLIED TO READING

The interested reader will find that the format which follows closely parallels that used by Cady with one exception. Cady examined term usage before applying the definitional approaches. This presentation reverses them.

Synonyms and Antonyms

"Reading" has few perfect synonyms and no perfect antonyms. Several terms in common use, seem synonymous for part of what is included in the term "reading." These would include scanning, skimming, perusing, the reading act, and the reading process. The lack of antonyms calls attention to the fact that "reading" is a positive term which has no negative counterpart. Nonreading, a forced negative term, would be such a diffuse entity or activity that it would defy definition. Loosely related antonyms can be found, but they seem to provide little help since the relationship of those terms as antonyms to "reading" would be tenuous. Examples here are such terms as "ignorance" and "illiteracy." Typically, it is used to connote the inability to process language, however, that inability is not a direct opposite of reading.

The synonyms, "skimming" and "scanning," are incomplete synonyms for "reading." Both of these terms refer to an activity which fails to encompass the entire message being read. As such, they are not direct synonyms but rather terms for specialized instances of reading, instances in which only a portion of that which is involved in reading are being denoted.

The term "peruse" has a dictionary definition which makes it synonymous with "reading," "To read carefully or critically for revision or study of; to examine closely by, or as if by,

reading; loosely, to read."[15] In common usage, however, its definition is expanded to encompass the activity of a close look at some object or situation.

The terms "reading act" and "reading process" provide additional semantic difficulties rather than resolving them. They are frequently accepted as synonyms to the term "reading," however, the definitions of "act" and "process" vary from individual to individual and consequently the combined terms have complicated, multiple meanings. These multiple meanings were encountered during the deliberations of the planning team. The term "reading act" to some meant only the activity of moving the eyes and the inputting of information in the mind. Others thought it encompassed the material to be read, the message contained in that material, the knowledge possessed by the reader, the processes employed by the reader, and the outcomes evolved through the interaction of those elements. Persons promoting this latter meaning of "act" used the term "process" to denote the physiological and mental aspects in reading. These two groups held apparently opposite meanings for the terms "act" and "process." Given this complication in joint terms that are synonymous with "reading," they fail to serve the objective of clarification in this definitional attempt.

The lack of true synonyms that encompass all that is meant by the term "reading" renders this approach at definition unproductive.

Ostensive Definition

Cady states that ostensive definitions are accomplished by indicating the thing or object being defined or by describing the item in terms of its denotata. Certainly things are included, both animate and inanimate objects are present when reading takes place. These include a message to be read and the individual. It is insufficient, however, to define "reading" as those concrete objects. Their mere presence does not guarantee that reading is occuring. Rather, reading seems to involve these things in some activity or process that is multifaceted. As such, reading is a non-thing, an interaction of thing and process that defies exemplification. It has been suggested that reading is nonexistent. That it is rather a construct invented by man to explain a complex interaction. Such an analysis supports the contention that exemplification is not a facilitator of definition.

One can point to instances in which reading is occurring. Similarly, results of the activity can be identified. Neither of

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[15] Webster's New International Dictionary Second Edition Unabridged. Springfield, Mass.: G & C Merriam Co. 1957.

these can be accepted as ostensive definitions. There are in turn the establishment of the locus of the activity, where and when it is occurring and the determination of the consequences of reading. Neither can be accepted as reading per se.

Ostensive definition leads to the suggestion that reading is a multifaceted interaction, not a physical entity that can be exemplified.

Comparative Definition

Comparative definition aids the definitional process by the delineation of the items to which the focal term is related. For example, "cold" is understood by learning the subtitles of its relatives, "hot," "warm," and "tepid." As these are delineated, cold is more precisely defined.

The consideration of "reading" as a subsystem in the larger system, language processing, sets the stage for comparative definition. Three terms signify other subclasses of the genus language processing. These sister terms are "listening," "speaking," and "writing." Two other phrases "teaching of reading" and "uses of reading," are linked with reading frequently enough to merit their description here. An effort will be made to indicate the similarities and differences in the sister terms in relation to the central focus of this discussion, reading. (A more extensive discussion of these related terms and their interrelationship can be found in the Sixtieth NSSE Yearbook.)

Reading and its three related terms in language processing were described to the Convergence Planning Team by one of the project consultants. To him the larger system consists of six elements as displayed in the diagram below.

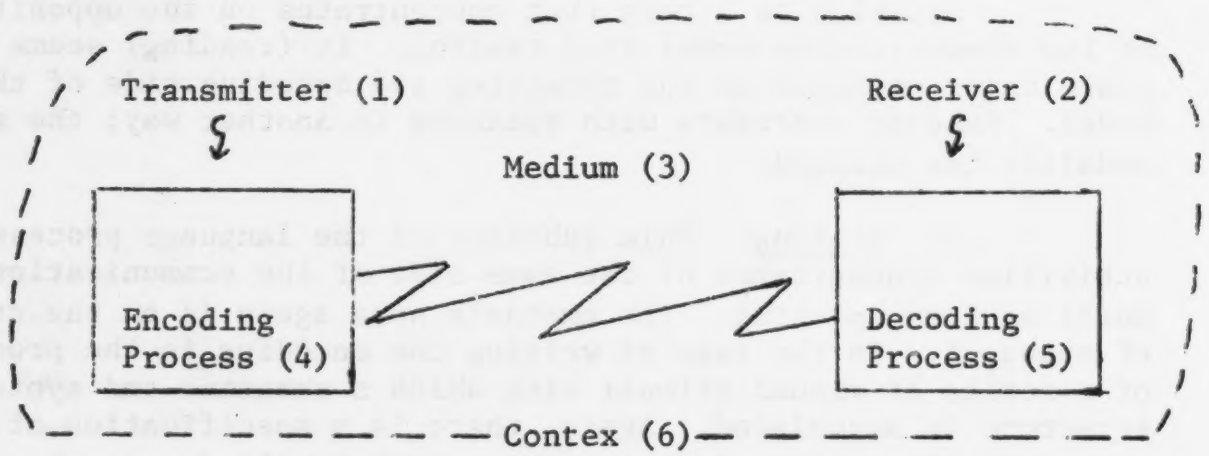

Fig. 1. The Elements of Communication. (Presented by T. Sebeok)

Communication requires the existence of transmitting and receiving units (Items 1 & 2 in the model). The transmitter must engage in a process of encoding a message, thus an encoding

system (Item 4) is mandatory. The encoded message is delivered to the receiver via some medium (Item 3). The recipient of the encoded message must convert it to meaning. Thus, the system requires a decoding mechanism of process (Item 5). All of this takes place in some context or setting (Item 6).

1. Speaking. Meaning is transmitted from individual to individual in two general modes, visual and aural. The process of creating aural symbols that have meaning (at least to the transmitter) is speaking. The focus of this term is on the transmission activity including the transmitter, the encoding system and the transmission medium in the communication model. Although its focus is on the tramsmission end of the communication paradigm, speaking interacts or places constraints on the other three units. Meaning is encoded, that is, semantic, snytactic structures are loaded on sound waves through the creation of patterns of amplitude and frequency. This aspect of communication requires a medium for transmission that is supportive of sound waves. Thus, the medium and the context are to some degree specified.

Without a receiving unit and decoding processes communication does not take place. The necessity of the receiving unit is self-explanatory. Decoding is not so straight forward. Decoding is the obtaining of meaning from meaning-bearing waves. To decode the receiving unit must already have the meaning contained in the message and engage in an associational activity or the message must be capable of generating in the receiver through the synthesis or analysis of its elements, the encoded message. In other words, if individual A is to make utterances that contain meaning that individual B is to understand, B must already possess the association between those utterances and a semantic and syntactic structure, or, he must be able to generate the semantic structure from the elements of the message.

Speaking is a term that concentrates on the opposite end of the communication model from reading. It (reading) seems to place major emphasis on the receiving and decoding side of the model. Reading contrasts with speaking in another way; the sense modality has changed.

2. Writing. This subclass of the language processing activities concentrates at the same side of the communication model as does speaking. The emphasis here again is on the creation of messages. In the case of writing the encoding is the production of a series of visual stimuli with which a semantic and syntactic structure is associated. Again, there is a specification of the nature of the medium, it has to be one that will freeze the visual stimuli and transport them to the receiver. The nature of the encoded message makes impositions on the receiver and the decoding process, they too have to be visually based.

Writing, as did speaking, contains a primary focus on the opposite side of this communication model from reading. Writing involves the visual modality of sensing and in this respect is more like reading than is speaking.

3. Listening. This process focuses on the reception side of the communication model. It is the activity that is engaged in by the receiver as he is decoding. Since it is aural in nature, it provides constraint on the context, the medium, the transmitter, and the encoding process. Listening and reading then are alike in their concentration on the reception end of the communication model. They differ in the modality, reading being visual, and listening, aural.

Other Related Phrases, "the teaching of reading" and "uses of reading," can help provide an understanding of the term "reading" if distinction can be maintained between them. As a term, "the teaching of reading," has an obvious link with reading, so obvious that the two are frequently used interchangeably. On a purely logical basis, the teaching of reading and reading cannot be identical in meaning. If that were the case, there would be no meaning for "the teaching of" part of the phrase.

As indicated elsewhere in this section, reading is an interaction that involves material to be read and behavior of the reader. The phrase, "the teaching of reading," is a focus on teaching a specified behavior. Thus, the teaching of reading involves the establishment of conditions whereby:

1. The cognitive aspects of the behavior, reading, are mastered by the learner.
2. The conditioned responses are learned
3. The expressive language of the behavior is mastered by the student.
4. The data required for participation in that behavior are either available or generatable by the learner.[16]

Those things done by the teacher to establish these four conditions are the items intended by the term "the teaching of reading." They are distinctly different from and are engaged in to produce the product, reading. For example, one teacher of beginning reading known by the author asserted that her children had no trouble with the left to right progression across the print. She played a game with her students which involved driving a toy car across the printed matter she put on the board in front of them. The car was kept in a toy garage at the far left edge of

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[16]Asahel Woodruff, First Steps Toward Improving Instruction. University of Utah, Salt Lake City, (In press).

the board. As she worked with them she made repeated references to the car's normal place and the direction it had to go. Those things, i.e. the placement, use of, and words about the car, were things done by the teacher to affect the behavior. They constitute the teaching of the behavior and are not the behavior itself.

One other term needs to be examined in this area. Some people include in the definition of reading items which can be understood as "the results of reading." Clymer illustrates this when he says,

> At the other end of the continuum, reading is viewed as resulting in a changed view of life which produces corresponding changes in behavior.[17]

To illustrate the difference between reading and the results of reading, one planning team member offered the following episode: A man looks at a printed message and then retrieves a ten dollar bill from beneath a nearby book. The message told him where the bill was hidden and invited him to take it. Clearly, the activity of physically retrieving the bill is not reading. Just as clearly, reading had occurred before this result of reading took place.

The relationship between "reading" and the "results of reading" can be described in systems analysis concepts of input, process, and product. In reading the input is of two sorts: a message to be read, knowledge possessed by the reader, and the processing capabilities he possesses. The process component includes those things done in the interaction of these inputs. The outcome of that doing is the product. Whether it is overt or covert behavior the product is not reading for it becomes the display after the input and the interaction cease.

Comparative definition delineates reading as an aspect of the language acquisition and processing or communication class similar to writing in the sense modality used; and similar to listening in that it is a reception focused subcase. This definitional approach further helps us differentiate reading from the teaching of reading and from the results. Both of these latter cases require the examination of the term "reading" on a means-end continuum. The first, "the teaching of reading," is a means to an end, the creation or generation of reading. In the second, "the results of reading," we find reading as a means to an end. In neither case are reading and its related term the same entity.

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[17]Clymer, Op. cit. p. 27.

Structural Definition

The structural approach to definition attempts to answer the question, "What are the components or parts of reading?" The work of Louis Guttman[18] on Facet Analysis and Design gives some guidance in the determination of "part." Guttman suggests that a variety of definitions related to the problem area be examined to determine those elements of the definition which are common but variable. Each such item he labels a facet of the problem area.

Applying this approach to reading leads to the delineation of three facets. Every definition of reading either implicity or explicity implies the existence of material to be read. If all printed or written messages are eliminated, reading would cease to be. At the same time, there is variation from message to message. Thus, material to be read seems common to all things defined as "reading," yet variable from instance to instance. This variation can range from the message which contains a single symbol with restricted meaning to multiple symbols with both surface and deep structural meaning.

The second facet is knowledge possessed by the reader. Input of information from several areas leads directly to the conclusion that reading is possible for persons with language or communicable concepts. Again, the knowledge possessed by a reader is variable. This is seen to some extent, in the study of reading difficulties experienced by children from disadvantaged environments. In such instances, the child has lacked both the practice in using language, and, contacts with a varied environment which help him develop a store of concepts. Such deficits frequently correlate with poor achievement in reading.

The third item which appears either implicity or explicity included in definitions of reading includes the physiological and intellectual activities engaged in by the reader. These items differ from the reader's knowledge. Perhaps the clearest distinction is made by contrasting the visual activity of reading with the concepts the reader must know in order to process the message. The former includes eye movements, the electrochemical processing of the brain, the neurological activity of forming an image and associating that image with already existing concepts in the mind. The latter encompasses those already existing concepts. As in the case of the two earlier facets, variation can be seen in the physiological and intellectual

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[18]See Philip Runkel, Some Recent Ideas in Research Methodology, ERIC Document ED 010 221.

activities. Eye movement and perception studies document such variation.

Three facets of reading defined above can be further subdivided. This needs to be done before a suggestion of the interrelationship of these elements is undertaken.

Material to be read is a message encoded in visual form, a message which bears meaning intended by the person who encoded it. As such it has the following:

1. Grapho-phonological structure
2. Syntactic structure
3. Semantic structure

Linguists have determined that all language can be described with a small (approximately 20), finite number of binary structures in sound production. This assertion is based on findings that languages exist in oral, or, written and oral form but not in written form alone. Thus, oral language is basic. An example of these binary structures is the differentiation between the "th" sound in "the" and the "th" sound in "thing." In the first, the voice is causing modulation in sound. In the second, the "th" is not voiced. Thus, an off-on computer-like binary entity exists. Others can be identified. Linguists indicate that of the approximately 20 structure that describe all language, any given language uses only 8 to 10. Written languages involve the establishment of visual symbols which represent combinations of these binary phonological structures. A finite number of visual symbols represents the possible combinations of the phonological structures. These comprise a grapho-phonological structure which carries some aspects of the meaning of the message.

Linquists indicate that a second manner of conveying meaning in a written message is through the syntactic structure generated by an author. The content of that assertion can be seen by examination of a test sentence used by linguists, "Pirots carolize elatically."[19] A reader can accept that set of grapho-phonological elements as a sentence and, because it has grapho-phonological structure, can repeat it orally. In doing so, some meaning is conveyed. The first unit bears noun characteristics; further it is plural, it refers to more than one item in a class. The second bears verb form characteristics. And, the third connotes some quality aspects. The entire phrase is very much like the sentence, "Babies wiggle happily." Even though the specific elements fail to connote any specific meaning,

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[19]It is believed that this structure was proposed first by Rudolph Carnap in his work on the logical analysis of syntactics. At this writing the exact source has not been found.

the entire expression has a type of meaning. This meaning is inherent in the syntactic structure. Variation in that structure carries with it variation in meaning. Consider, "Elatically carolize, Pirots." Again, the individual elements have grapho-phonological structure but no specified meaning, no semantic content. When placed in this manner there is a decidedly different sense of meaning than when placed in the earlier format.

The third aspect of the message to be read is a semantic structure. By combining graphemes in various ways symbols for concepts are created. In the example above no semantic base exists for the symbol "pirots." In the sentence, with which it was contrasted above, "babies" contains meaning. This third aspect of meaning is less well understood than the other two but is just as obviously there.

In combination, these three structures make possible an infinite variety of meaning. By combining the small finite number of phonological elements in various ways, a larger but still finite number of grapho-phonological structures are created. When these grapho-phonological structures are grouped together a large number of word forms is created. The placement of those forms in various orders (syntactic structure) still further expands the number of possible meanings. Finally, when the possible semantic variation is considered the variety of meaning that is possible to produce is infinite. Linguists indicate that existing research is most positive in the area of grapho-phonological structure, somewhat definitive in relation to the syntactic structure, but not at all definitive in the area of semantics.

The second facet of reading listed above is knowledge possessed by the reader. It too can be subdivided. In this case the suggested subdivisions are:

1. Facts, either held independently or in some relationship with other facts.
2. Rules, principles, concepts, or contructs.
3. A category encompassing attitudes, values, and beliefs.

It is clear that each of these categories is involved in reading. It is not clear as to the exact role each plays. Logically, it is acceptable that a person who possesses nothing in these three categories is incapacitated when presented a message to be read. The effect of deficiencies in one or two of these categories is not clear. Some of the work currently being done on the teaching of reading to disadvantaged children implies that individuals with deficits in the area of knowledge possessed are at least retarded in their ability to learn to read. The conclusion most generally accepted from such work is that without prior knowledge reading cannot be created.

Physiological and intellectural activities comprise the third facet of reading. Common discourse mixes these latter two facets. To some people these activities are referred to with the term knowledge and vice versa for others. In this presentation the phrase, "physiological and intellectual" activities, encompasses the physiological aspects of vision and the electro-chemical processing in the brain. Kenneth Goodman of Wayne State University has evolved a tentative model of reading which delineates them. His list includes:

a. Scan. (The movement of the eye on the page either to the right and down line by line or down the page or on the contiguous blackness of a single symbol.)

b. Fix. (The stopping of the movement and refining of the focus of the eye.)

c. Select. (The mental activity of entering in short term membory cues form the visual array.)

d. Form. (The establishment of a perceptual image in medium term memory using the cues selected in the prior stage.)

e. Search. (The activity of examining long term memory and perhaps medium term memory for grapho-phonological, syntactic, and semantic cues related to the perceptual image formed in the prior stage.)

f. Compare. (The matching of items identified in the memory search with the perceptual image.)

g. Choose. (The selection of cues to hold in medium term memory that fits with the perceptual image.

h. Test Choice. (The examination of the cues which the individual has chosen to hold against the semantic and syntactic context generated through prior chosen cues.

i. Decode. (Integrate the items which when tested fit with the semantic and syntactic meaning accumulated through prior choices. This integration results in either reinforcement of already held meaning in long term memory, the modification of that meaning, or the addition of new meaning in that long term memory.)

j. Recycle. (Start at the scan activity in the sequence again.)

Two additional activities are built into Goodman's model. It is possible that in the comparison of the image that

has been formed and the cues which are being held in short term memory that it is not possible to make a choice of cues to hold in medium term memory. In this case, the reader in effect tests those cues with a recalled version of the perceptual image.

The other item needed is one which explains the regression activity seen in reading. This, Goodman theorizes, occurs when our choices of images to form and to hold in medium term memory fail to fit with anything being stored. As a result, regressive eye movements, that is, movement backward along the line and up the page can be explained. In this the reader is trying to determine whether prior choices omitted some item. This regression moves the activity in effect back to the level of fixing.

Goodman presents one assumption which is basic to the skills described above. That assumption is that reading is a sampling process. When reading, wide array of visual stimuli are available. In the movement of the eyes and fixing on a spot still a large quantity of visual stimuli is in range. Some of this material is in sharp focus while some is in diffused focus; the individual selects cues both from that sharp and diffused context. Those cues are tested against prior experience. Predictions are made as to their utility for meaning and, thus, the selection for stored items. The work that has lead to this model of reading skills involves the analysis of "miscues" (errors) made in oral reading by proficient readers at approximately fourth grade level.[20]

In summary, for a structural definition approach, reading consists of: a message encoded in visual form which has grapho-phonological, syntactic, and semantic structure; the facts, rules attitudinal knowledge possessed by the reader; and physiological and electrochemical processing activities acquired by the reader. That reading is an interaction of these is hopefully established in the discussion under the heading Ostensive Definition. Certainly, it is not the simple sum of material to be read, knowledge possessed, and physiological and intellectual activities. It is something more than the juxtaposing of those entities. It is their interaction. Further, it is hypothesized that reading is a sampling process in which cues from the grapho-phonological, syntactic, and semantic structure of the message. Finally, it is hypothesized that because each of these three facets varies, the interaction takes on differing nature over time.

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[20]Kenneth S. Goodman, "Study of Children's Behavior While Reading Orally." Final Report USOE Project No. 5-425, March, 1968.

Classificational Definitional

In this approach at definition we are attempting to answer the question, "Where does reading fit?" Such an attempt requires the delineation of the character of the classification system as well as the establishment of reading's position in that system. In part, this definitional attempt has already been explicated in the argument presented earlier for classifying "reading" as a relative term. In that section it was proposed that "reading" is a subterm in a class labeled "language acquisition and processing." As indicated, its sister terms in that class are "speaking," "writing," and "listening."

At this point, it seems imperative that the relationship between reading and learning be discussed as a basis for determining reading's classificatory locus in education. Reading can be described as a continuum from simple decoding of a message through literal comprehension of that message to and including critical comprehension of that message. The first of these, simple decoding, took on quite a restricted meaning after Kenneth Goodman spoke to the planning team. In most cases the discussion of simple decoding includes only the conversion of visual symbols to oral symbols, in other words, the symbol-sound associational activity. Goodman asserts that that activity is not an actual decoding but a recoding.[21] In this sense, decoding means the obtaining of meaning from a code, a set of symbols. When an individual converts a set of visual symbols, printed material, to sound, he is not necessarily producing the meaning. Rather, he is producing a different encoding for that meaning. If this material were read aloud, the sounds made would not be the meaning. That meaning exists in concepts and constructs in the minds of the reader and the persons hearing the message. Thus, the conversion form visual to oral symbols is not decoding but recoding. This analysis makes it no less important. It does help gain some perspective on the activity.

The continuum stated above was interpreted by members of the planning team in the following terminology. At one end, the focus is on, "What are the sounds for these visual symbols?" In the middle, "What does this set of visual symbols say?" At the other extreme the question is, "What does that saying mean?" The midpoint, the what-does-it-say locus of this continuum, is to many people, the focus of the reading instruction activity in which schools engage. At the point that the individual is able to take a printed or written message and respond at the what-does-

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[21]Kenneth S. Goodman, "The Psycholinguistic Nature of the Reading Process." in The Psycholinguistic Nature of the Reading Process. Ed. K. S. Goodman, Detroit: Wayne State University Press, 1968.

it-say level in their perception, proficient readers have been produced. The first planning team was reluctant to structure a definition of reading which would cease at that point. They believed it important that the definition of reading move into the area of critical comprehension. In this respect, they argued persuasively for inclusion of activities of analysis, interpretation, categorization, and evaluation as aspects of reading.[22]

The inclusion of critical comprehension as a part of reading creates some difficulty. At times these activities seem to be a part of reading and, at other times, they are engaged in outside of reading. Example: in reading a report of a research project an individual might encounter an author's hypothesis statement. As he reads further, he encounters the description of the research design. In that design the elements of the hypothesis are operationalized by stating the activities that took place and the tests that the reader no doubt stored in his memory a meaning (literal comprehension). As he reads the description of the design and of the measuring techniques, he might encounter material which effects a modification of the meaning of that hypothesis. In this respect, he is engaging in an evaluation while reading.

Many individuals have experienced the situation in which they were asked to read the research report, and, at a later point in time, asked to verbally analyze that report. In such an instance, the written material has been examined and, at least, a literal comprehension, a what-does-it-say state, achieved. The printed material, at this point, is set aside and, at a later point in time, an examination of that message, as it now exists in the individual's memory, is undertaken. The concepts and constructs are explored, examined, and evaluated. He might recognize from the discussion that the measurement and design actually test a hypothesis different from the one stated by the researcher. Although the same conclusion is reached it is obviously done after the reading.

In this deliberation it is recognized that reading and some thought processes in learning are similar. The question is, "Where should the demarkation line be drawn?" What is reading and what is thinking? This question is resolved here by the specification of a time dimension. If the intellectual activity involved in the analysis, interpretation, synthesis, and evaluation of a printed or written message is concurrent with the physiological reading activity, that mental activity is included as an aspect of reading. If the evaluation occurs through an oral

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[22]Support for this argument can be seen in the works summarized by Clymer under the heading "Comprehension Models." Op. cit. p. 14-27.

discussion or mental consideration after the material to be read is placed aside, it is not considered reading. In this respect, reading can be seen as a skill to be acquired in school and as a skill which is utilized in acquiring knowledge. In that latter capacity, it sometimes involves activities which can be seen when reading obviously is not taking place. These activities include the critical examination of the nature of a statement or construct, the analysis of its constituent elements, the evaluation of the logical consistency as the message moves from one element to the next, and the evaluation of the quality or character of the message. Again, simultaneity is the distinguishing factor. When they occur without the simultaneous visual processing, they are not considered reading activities.

In summary then, the classificational approach at definition highlights the relationship of reading with the other subclasses of communication. Further, it pinpoints a number of activities that are encompassed within reading at times and external to reading at other times.

Operational Definition

The focus of this approach at definition is the question, "How does it work?" In prior sections an attempt has been made to delineate those terms which stand for reading, what reading is like, what it consists of, and how does it fit in classificational systems. In doing so, some discussion of the working nature of reading has been included. This section builds those earlier references into a hypothetical statement about the manner in which reading occurs.

At the outset, several points need to be emphasized. First, earlier aspects of this presentation have maintained that reading always includes certain elements. Here the referents are a message to be read and its divisible structures, the categories of knowledge possessed by the individual, and a set of physiological and intellectual activities engaged in by the individual. At another point in the material above, it has been indicated that examinations of reading will identify entities which will appear different at different points in time. Here the referents are simple decoding or recoding, literal comprehension, and critical comprehension. Each of these appears distinctly different.

The assertion that reading always consists of the same elements yet on different occasions looks entirely different, can be handled conceptually. Reading in this respect is analogous to the four lines of music sung by a quartet. The soprano, alto, tenor, and bass lines each are discrete and move throughout the musical selection. At any given point in time in that musical selection, the four lines of music may be merged on a single note. At that point, the rendition has a sound that is considerably different from the sound at another point in time when four separate notes can be heard by the listener. Thus, a musical

rendition by a quartet has both a horizontal dimension and a vertical dimension. The former consists of the four separate melody lines. The latter consists of the combined sound of the four voices at any one point in time. Reading has these same two dimensions. It is asserted that the three facets, message, knowledge, and skills, can always be found. It is further asserted that these three facets interact in varying ways at any particular stage of reading development. The former is the horizontal dimension, the latter the vertical.

At this point in time, it is only possible to describe part of the operation, reading. The status of the field to date allows for a hypothetical operationsl definition which suggests the kinds of knowledge and activities that might be involved. To date, this developing model fails to take into account variations in the structure of messages to be read. Thus, the operational definition effort undertaken below is acknowledged as incomplete.

Figure 2 is a modification of a model of proficient reading developed by Kenneth Goodman of Wayne State University. This model was evolved through the analysis of the "miscues" made by proficient fourth grade readers. (Goodman uses "miscues" as a non-loaded synonym for "errors.") Basic to the model is the assumption that reading is a sampling activity. That is, the reader observes a large set of visual stimuli and samples from that set certain cues on which to proceed in converting the code to meaning.[23] Given that assumption, it is possible, using Goodman's model, to explain in a logically tight manner, the activities required to move from the existence of material to be read to meaning in the mind of the reader. That logic encompasses the steps identified under the heading "Structural Definition" and detailed as shown on Figure 2. The first is SCAN: the individual moves his eyes in prescribed ways to pass them over the page. Those prescribed ways must coincide with the rules employed by the transmitter, the author, as he encoded the message. If the symbols system is designed so that the encoding takes place on a vertical pattern, the can program (to use a computer analogy) must direct the eyes in that vertical pattern. In this culture, messages are encoded in visual patterns which moves from left to right, line by line, down the page. This, the program for scanning is specified.

In that scanning, the eyes make a general focus on the page, focus which is refined with the FIX activity. This appears to be the stoppage of movement, at least in movements observable to the eye, and a slight refining of focus on the spot toward which the line of vision is now directed. Fixing causes a section of the printed material to be in sharp focus and a still larger section

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[23]Kenneth S. Goodman, "Reading: A Psycholinguistic Guessing Game." Journal of the Reading Specialist, May, 1967.

A FLOW CHART OF GOODMAN'S MODEL OF READING

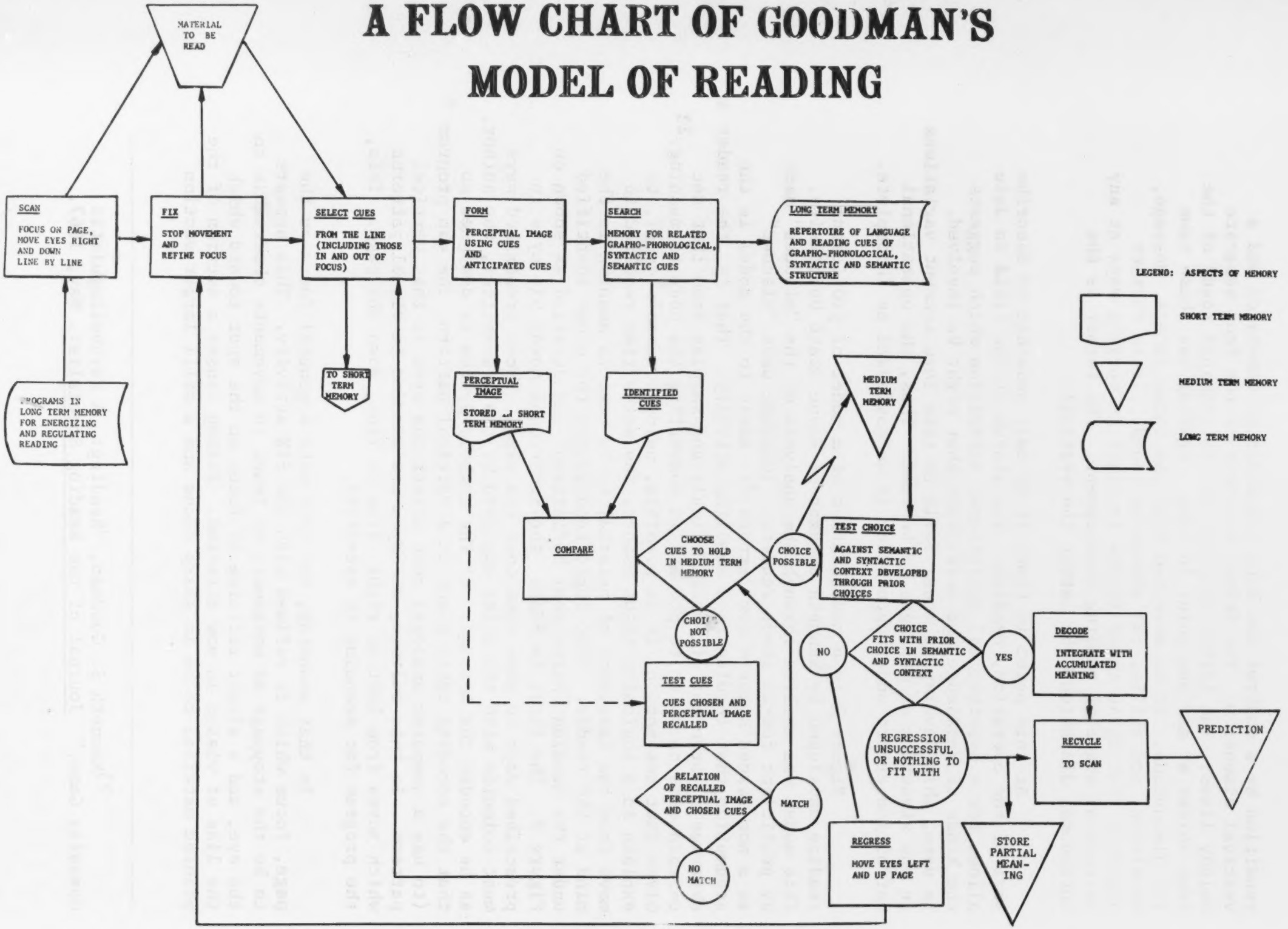
MATERIAL TO BE READ
SCAN
FOCUS ON PAGE, MOVE EYES RIGHT AND DOWN LINE BY LINE
FIX
STOP MOVEMENT AND REFINE FOCUS
SELECT CUES
FROM THE LINE (INCLUDING THOSE IN AND OUT OF FOCUS)
FORM
PERCEPTUAL IMAGE USING CUES AND ANTICIPATED CUES
SEARCH
MEMORY FOR RELATED GRAPHO-PHONOLOGICAL, SYNTACTIC AND SEMANTIC CUES
LONG TERM MEMORY
REPERTOIRE OF LANGUAGE AND READING CUES OF GRAPHO-PHONOLOGICAL, SYNTACTIC AND SEMANTIC STRUCTURE
PROGRAMS IN LONG TERM MEMORY FOR ENERGIZING AND REGULATING READING
TO SHORT TERM MEMORY
PERCEPTUAL IMAGE
STORED in SHORT TERM MEMORY
IDENTIFIED CUES
MEDIUM TERM MEMORY
COMPARE
CHOOSE CUES TO HOLD IN MEDIUM TERM MEMORY
CHOICE POSSIBLE
TEST CHOICE
AGAINST SEMANTIC AND SYNTACTIC CONTEXT DEVELOPED THROUGH PRIOR CHOICES
CHOICE NOT POSSIBLE
CHOICE FITS WITH PRIOR CHOICE IN SEMANTIC AND SYNTACTIC CONTEXT
NO
YES
DECODE
INTEGRATE WITH ACCUMULATED MEANING
TEST CUES
CUES CHOSEN AND PERCEPTUAL IMAGE RECALLED
REGRESSION UNSUCCESSFUL OR NOTHING TO FIT WITH
RECYCLE
TO SCAN
PREDICTION
RELATION OF RECALLED PERCEPTUAL IMAGE AND CHOSEN CUES
MATCH
NO MATCH
REGRESS
MOVE EYES LEFT AND UP PAGE
STORE PARTIAL MEAN-ING
LEGEND: ASPECTS OF MEMORY
SHORT TERM MEMORY
MEDIUM TERM MEMORY
LONG TERM MEMORY

Figure 2

of that same material in diffuse focus on the retina of the eye. According to Goodman's major assumption, cues are selected in reading both from that material in sharp focus and material which is adjacent to it but not in focus.

From the visual pattern on the retina the next activity, SELECT, proceeds. It is described as the mental activity of entering into short term memory cues selected from the visual array. The exact nature of this cue selection activity is not known. Physiologically it is known that nerve ends in the retina are sensitive to light (wave frequencies). Why or how the stimuli applied to some nerve ends are used and others are not are research problems directly generated by the Goodman sampling assumption. Thus, the suggestion that a selection activity is going on immediately identifies two possible research activities. The cue selection activity itself should be the initial focus for research activities. Contingent upon data from such studies, the possibility of a hierarchy of facilitating cues needs investigation. (These two items are indicative of the Convergence Technique approach. By setting a goal, delineating a starting place in the movement to that goal, and making explicit the assumptions in the achievement of that goal and in the substantive area defined as the starting place, some research efforts can be prescribed in a sequence. The conduct of those research activities will provide data on which to base movement to the next level of research or the modification of the logical structure represented by the Convergence Chart.)

Accepting Goodman's assumption, at this point, demands that a selection of cues aspect be included. The selected cues are used at a later point in the cycle. Thus, they must be held in some form or another. Thus, the model indicates the insertion of these cues into short term memory (duration in this case is guess-timated at a quarter second).

The next do-box in the model is FORM. Its inclusion suggests the formation of a perceptual image in the mind. The reader in effect turns away from the print while holding in his mind the item that is constructed of those cues selected off the page. This perceptual image is stored in medium term memory (duration in this instance in the neighborhood of 10 minutes).

At the same point that that perceptual image is stored, a SEARCH through long term memory is initiated. This search is hypothesized to be directed at the identification of grapho-phonological, syntactic, and semantic structures (already known by the reader and stored in his long term memory) that are related to the cues selected and the perceptual image formed. In effect, the human computer is asked to search its memory and print out a listing of the things already known that might compare with the cues from the visual stimuli.

Both the perceptual image held in medium term memory and the identified cues from long term memory lead into the next activity, COMPARE. As this comparison is run, the reader chooses cues to hold in medium term memory. In effect, he is using prior experience or prior knowledge as the criterion to confirm that the cues selected from the page and formed in a particualr perceptual image have the meaning he has predicted.

At this point Goodman's sampling assumption requires elaboration. In sampling Goodman indicates that the reader forms partial images that are used (when compared with prior knowledge) to predict the complete image. An analogy to an activity in art helps make this point clear. In learning how to visually represent a given form, art students are sometimes asked to draw an object by showing the intersection of lines only. That is, a table would be shown by short lines that meet at its corners, at the intersection of the table top and its legs, and at the junctures of the legs with the floor. A surprisingly solid representation is predicted through such drawings. The reader may, in effect, select cues or parts of visual codes and use those codes to predict the entire image. The following symbols suggest that Goodman's acceptance of this prediction activity is not illogical. His model fails without it.

SAM HIT THE BALL

If it is not possible to make such a choice of cues to hold in medium term memory, the reader moves into a TEST CUES activity. In such a case, two possibilities seem logical. Either the perceptual image that was compared with the cues identified in the memory search did not encompass all of the perceptual image that was formed by the originally selected cues, or not enough cues were selected from the page to enable the resolution with items in long term memory. Thus, the individual who is unable to make a choice of which cues to hold in medium term memory re-examines the perceptual image. If there is a match between the re-examined perceptual image and the chosen cues, the reader moves again to the choice of those cues to hold in medium term memory. If no match exists, it is possible that insufficient cues were selected initially. In such a case, the reader turns back to the printed page at the point of the earlier FIX and selects additional cues with which to form an expanded perceptual image and to compare to already held cues in long term memory.

If a choice of cues to hold is possible, they are inserted in medium term memory and a TEST CHOICE activity conducted in which those cues are tested against semantic and syntactic context already developed and stored by prior choices. In other words, as the reading progressed such choices were being made, cues were being chosen and held in medium term memory. As the number of

chosen cues build, they fit together to form semantic and syntactic meaning. Thus, chosen cues are tested against the context developed through prior choices.

If a fit is possible among the stored cues, the individual DECODES. That is, integration is undertaken and that new meaning deposited in long term memory and the cycle is repeated. If it was impossible to fit the cues chosen with the semantic and syntactic context developed through already chosen cues, a REGRESS activity takes place. The eyes move horizontally to the left and vertically up the page seeking cues that may have been missed in earlier cycles.

Goodman's model, as was indicated earlier, was developed through analysis of observations of proficient readers at the fourth grade level. It is, in effect, that vertical look at reading analogous to examining the sound of the four notes of a quartet at any one point in time. If the earlier assertion about horizontal consistency in reading holds up, these activities ought to be discernible in differing levels of reading development. Concurrently, if Goodman's model is an effective one, it ought to be applicable to the differing levels of reading development. The beginning reader scans, that is, he moves his eyes. The reader engaged in identifying the action line in a story also scans. The proficient fourth grade reader scans. However, the details of that scanning vary in each of the three cases. Further, the scan activity in reading in another culture varies. Therefore, it is possible to assume that SCAN is always present but that the details of scanning vary in complexity (In computer language different levels of programing are required). Similarly, the child who is a beginning reader FIXes as does the proficient fourth grade reader as does the college student. The detailed instructions which would guide these fixations differ. The mature reader examining printed material for the identification of the story action may fix on action verbs and select from the syntactic structure surrounding that action verb, meaning cues from which to generate the story action line. The beginning reader may fix on the contiguous area of blackness and select cues about that structure. The same distinction between program complexity for different achievement levels in reading can be made for the other actions in Goodman's model. In so doing, the developmental stages of reading can be conceptualized as differentiation in programing in a stack of the flow charts depicted in Figure 2. Beginning reading would be represented by a flow chart with simple programs for each of the actions. As the reader becomes more accomplished his repertoire of programing expands to encompass greater complexity in skills.

Throughout this section statements have been made that can only be tenuously held. For the sake of presentation and as a base for definition they were sometimes stated as accomplished fact.

Analysis of Usage of the Term "Reading"

Cady indicates that the analysis of term usage can further the definition of a complex term. In following his format "reading" would be described as:

1. a category as it becomes a name for a complex of objects and activities.
2. a particular term as it signifies a member of the language processing system.
3. a collective term as it treats a number of objects or properties as a whole.
4. a univocal term because at various times it is used with apparently different meaning.
5. a positive term as it signifies something rather than the lack of something.
6. a relative term in relationship with speaking, listening, and writing.

Instances can be observed in which "reading" is used as a general term, one which is an entity in and of itself. Such use has value BUT for a specific purpose and ought not to be undertaken without knowledge that the term has relationships to several others.

READING: SUMMARIZED AND SPECIFIED

Through the previous sections reading has been analyzed as a term and through a variety of definitional approaches. The combination of both of those activities generates a working definition as the initial base for the research proposed in the Application of the Convergence Technique to Basic Studies in Reading.

Term Analysis Summarized

"Reading" is used to refer to a category that has component elements which, when taken together, comprise a subclass of language processing or communication. As such, it is related to, and as a term draws meaning from the activities: listening, speaking, and writing. Both in professional and in common discourse, reading has various definitions which defy classification along a single variable, a fact that aids confusion in the field. From time to time "reading" is used as a general and absolute term. In this respect, we hear reading spoken of as an isolable entity, as an activity in and of itself, as a program or course of study. Such use has value for specific purposes. Use in this manner ought not to be undertaken without firm knowledge that the term has relationships with several other terms and is itself a complex multifaceted entity.

Definitional Techniques Applied to Reading

There are few terms which can serve as synonyms and no terms appear as antonyms for the term "reading." It is impossible to generate a number of terms that are partial synonyms, that is, that provide part of the semantic content provided by the term "reading." The antonyms, or opposites, of reading are so diffuse as to be valueless in providing boundaries for the semantic meaning of reading, itself.

The ostensive approach at definition leads to the conclusion that reading is not a physical entity. It is, rather, the interaction of several items.

The comparative approach to reading indicates its similarity to listening, speaking, and writing as means of language processing. Reading is like listening in that both are reception oriented or decoding aspects of communication. It is like writing in that both employ visual sensing. In this communication paradigm, reading is least like speaking, a transmission of oral sense meaning. The comparison of "reading" and "reading instruction" highlights the fact that instructional method consists of those things done and those materials utilized in obtaining an objective. As such, reading instruction involves; those things done to effect the conditioned elements of reading behavior, to generate the conceptual element of reading behavior, to provide the expressive abilities necessary in reading, and to acquaint students with ways of obtaining the necessities for the reading. All of these items relate to reading, the product of reading instruction. But even taken together, they cannot be accepted as the definition of reading, rather, they are the definition of reading instruction. Finally, reading can be compared with the phrase "the results of reading." Some definitions of "reading" would include the change in the individual possible through engaging in behavior, reading, as a part of the term. These changes, either behaviors and/or expanded or modified concepts, are not reading itself but a product of reading.

Structural definition delineates the constituent elements of reading as material to be read, knowledge possessed by the reader, and skills possessed by the reader. These three items are further subdivided: (1) Material or message as grapho-phonological structure, syntactic structure, and semantic structure; (2) Knowledge possessed by the reader into three rough categories - (a) individual facts, (b) rules, principles, and constructs; and (c) attitudes, values and beliefs, physiological and intellectual activities.

The interaction of these three takes on different appearance at various developmental stages. The beginning reader displays an activity which appears to be quite different from that of the accomplished reader. Yet, in both cases, a message to be

read, the reader's knowledge, and physiological and intellectual activities are involved.

Classificational definition focuses on where reading fits with related terms. In this respect, its relationship to speaking, writing, and listening were examined as was its position in education. Reading is highlighted as a skill to be acquired and a tool in the learning process. From one vantage point reading behavior can be described along a continuum from decoding to critical comprehension. There is little dispute that the decoding and even the literal comprehension aspects of this continuum are reading. Some disagreement is encountered on the critical comprehension level. In this activity mental processing activities labeled as interpretation, analysis, classification, synthesis, and evaluation. When these activities coincide with the interaction between material to be read, knowledge of the individual, and processing activities engaged in by the individual, they are herein defined as reading. When those activities occur and a message to be read is not simultaneously included, they are not classified as reading.

Operational definition of reading focuses on the assumption that it is a sampling and predicting process. The reader selects cues from the visual stimuli, forms images, and uses those images formed by sampling to predict the nature of the structure of the message. Through an accumulation and synthesis of such predictions meaning is generated in the reader's mind.

The Definition Specified

Before stating a summary definition here, there is a need to reiterate the earlier statement about the impossibility of one sentence or one paragraph definitions. The summation of all of the definitional approaches is intended as the definition. Only in such a manner will the brief definition which follows have the proper semantic structure.

"Reading" is a term used to refer to an interaction by which meaning encoded in visual stimuli by an author becomes meaning in the mind of a reader.* The interaction always includes three facets: (1) material to be read; (2) knowledge possessed by the reader; and (3) physiological and intellectual activities. The variability apparent when the interaction is viewed at different points in time is a result of the variability possible in each of the several facets.

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*NOTE: This definition does not imply that the meaning intended by the author automatically becomes the reader's meaning. Errors in encoding and decoding mediate against this one for one correspondence.

A PROPOSED RESEARCH PROGRAM GOAL

The participants in the Reading Definition Conference devoted some of their time to the goal or objective towards which a reading research program ought to focus. In their thinking the goal should be:

> To obtain reading behaviors appropriate for age level 9 and subsequently ages 13, 17 and adult. (At each level the program should focus on obtaining these behaviors on the part of 95 per cent of the population.)

APPENDIX C

GLOSSARY

TERMS RELATED TO THE CONVERGENCE TECHNIQUE AND/OR THE PRESENTATION OF THE RESEARCH PROGRAM

ACTIVITY--The work necessary to achieve a subobjective in the research program. This work is shown in the program plan as boxes which precede criteria statements. It is assumed that there are one or more projects which must be undertaken to complete an activity, that is, to satisfy the subobjective criteria.

CONVERGENCE TECHNIQUE--A research planning and management procedure developed by Louis M. Carrese. It involves the following:

1. A planning session which initially delineates:
   a. The goal to be achieved by a research program.
   b. The subobjectives necessary for the achievement of that goal.
   c. The sequence in which those subobjectives must logically be met to achieve the specified goal.
   d. The criteria which must be met before it can be said that the subobjective has been satisfied.
   e. The research which is needed to achieve each subobjective.
2. A chart which displays the five elements listed above.
3. The use of the chart in program management for decisions on:
   a. Specific research projects to be undertaken.
   b. Movement to the next subobjective activities.

CRITERIA--Those conditions which must be met to conclude that an activity is completed and that a subobjective has been satisfied.

This is one of the major distinctions between the Convergence Technique and other systems analysis procedures (PERT, CPM, etc.). It is assumed in the latter that if an event occurs it is satisfactory. Such an assumption is acceptable when the event is of the nature of "the truckload of steel arrives." It is not acceptable when the event is of the order, "a model of the reading process has been generated." In the latter case a number of criteria must be met by each model before program managers can conclude that work on the next event can proceed.

PHASE--In a program planned through use of the Convergence Technique, a phase is the largest subdivision of the logic

network. Each phase ends with the satisfaction of the criteria for attainment of a major subojbective such as, "Develop instructional packages which replicably produce the desired behaviors in 90% of the subject population." A phase may be subdivided into Activities (Carrese uses the term "steps") and then into individual projects.

PROGRAM ELEMENTS--The research plan presented in this report has three sections.

1. MAIN PROGRAM--The collection of research and development activities deemed critical to the achievement of the overall program objective. It depicts the sequential order of activities necessary for achievement of the goal. (Carrese uses the term "Linear Array" to cover this concept. Because of the existence of alternative paths to the program objective and the singularity implied in "Linear Array" this change in terminology has been made.)
2. SUPPORT PROGRAM--A variety of research and development efforts can be specified which would, <u>if undertaken</u>, improve the level of subobjective attainment in the main program. At the same time work in this program element is not necessary in the achievement of a Main Program goal. (Carrese calls this program element the Concurrent Array.)
3. HIGH RISK, HIGH PAYOFF PROGRAM--There are alternative approaches to the solution of a given problem that have a totally different logic underlying them. For example, the main program in the proposed research on reading assumes that reading skill will be developed through an interaction of student, teacher, instructional materials, equipment, procedures, and environment. An alternative assumption might be, "Children develop reading ability through their interaction with parents, television, and classroom assignments <u>except</u> those labeled 'reading instruction.' That is, they learn to read despite instruction." Pursuit of either assumption will produce a research logic, but the two logics will be quite dissimilar. We have more knowledge about, experience with, and faith in the former than the latter. The latter, if substantiated, however, would cause sweeping changes in the logic of the overall program. Therefore, research conducted under this assumption would fit the HIGH RISK, HIGH PAYOFF category. (Carrese calls this program element the Supplementary Array.)

PROGRAM OBJECTIVE--That which is to be accomplished by the program, the end goal. The program objective proposed in this report is,

100 percent of all people (not in permanent care institutions) over 10 years of age can complete 90 per cent of

a set of tasks which exemplify reading behaviors.

This objective has four subelements that need to be made explicit.

1. Population - the concentration is on those persons moving through the schools in the future. That is, the objective is to be met by constructing a system which will assure reading competence for all children by age 10. A second aspect of the population statement is the exclusion of those whose pathological conditions such as mongolism or frank brain damage would demand reading instruction that is grossly cost-inefficient.
2. The second element of the objective is a set of tasks that exemplify reading competence. It is recognized that reading competence is variable and that the program objective concentrates on a point on the scale describing that variable. It is asserted that neither that point nor the scale have been established by existing work. Therefore, a part of the main program will concentrate on the development of the literacy criterion for the program objective.
3. Performance level - The objective statement implies two concerns here. First, that mastery (90 per cent correct performance) be attained. Second, that that performance level be retained. The latter is what is implied in the phrase "over 10 years of age."
4. Resources - Although not explicitly stated, the program objective has a resource constraint. A system which will enable achievement of the program goal must be feasible within resources currently available for education and for the social support of the population now unable to read.

PROGRAM PLAN--This term refers to the sum of the activities displayed in the chart, and the operation of information and management systems. (Carrese uses the term, "Convergence Chart.")

TERMS CONTAINED WITHIN THE PROGRAM PLAN

ADAPTIVE EXPERIMENTAL LABORATORY (AEL)--On the assumption that systematic modifications of the way reading is taught may achieve the goal, an adaptive experimentation phase is included in the main program. An AEL is a setting in which reading instruction is on-going AND in which the systematic analysis of the nature and effects of reading instruction are used to modify the on-going program. An AEL can be described as a self correcting mechanism with the following characteristics:

a. Program is focused through established operationally defined objectives.
b. Discrepancy analysis between objectives and program performance is performed.
c. Program modification procedures are designed to minimize discrepancies.
d. Iterative recycling occurs.

INFORMATION SYSTEM--The careful pursuit of the program outlined in this report calls for an active information storage and communication system for data on reading and related processes encompassed in the Program Plan. It must provide the means for: (1) collection and retrieval of data; (2) an inventory of human and material resources that have been either identified or used in the program; (3) providing necessary information to program managers, investigators both in and outside the program, and to interested citizens; and (4) preparation of program progress reports as the work is completed.

INSTRUCTIONAL SYSTEM--Those materials and procedures assembled for the purpose of facilitating specific learning.

LITERACY DELIVERY SYSTEM--A variety of activities and materials are needed to make an instructional system operational. Included are the materials and procedures involved in the teaching-learning process AND those necessary for the creation and support of the instructional system. This latter category encompasses the items necessary for ensuring that the teachers and others know the details of that system and its operation, and for the continued maintenance of the system.

LITERACY--In this program literacy is equated to reading competence. It is recognized as a variable ranging from the inability to convert written language into meaning, through the ability to accurately convert written language into its literal meaning and the critical processing (including evaluation and synthesis) of the written language.

The proposed research program concentrates on assuring that all persons pass a specified point on the scale by age 10.

MAD DOG EMPIRICISM--The collection of frothy data by wildly lunging around with open ended data generators, data generators that are disconnected from (or by) logical frameworks, theories, or models.

MODEL--A representation of a system developed for the purposes below.

1. Describing what is involved in a system.
2. Retrospective explanation of how the system works.
3. Prediction of the workings or output of a system.

NATIONAL SAMPLE--A representation of the U. S. population at some age level or levels. Sampling variables would include socioeconomic status, ethnic groups, native (first) language or dialect, rural-suburban-urban residence, sex, and perhaps many others.

PARTIAL MODEL--A representation of a system that is incomplete in either or both of the following ways:

1. Does not encompass all of the elements of a system of interest.
2. Is not developed to the point that description, explanation, AND prediction are possible by persons other than the originator of the model.

READING--The process by which written language is converted to meaning in mind of an individual.

READING SYSTEM--The sum of three items:

1. The inputs to reading (material to be read, skills possessed by the reader, and his knowledge about the content of the written message).
2. The internal processes which convert the written language to meaning.
3. The outputs of reading (behaviors which are used as indicators that the process took place).

SYSTEM--A collection of elements and processes that are interrelated. Systems are described in terms of inputs, processes, and outputs. They may be open or closed, that is, they either exchange energy with elements outside the system boundary or they are self contained.

REPORTING STANDARDS--The degree of detailing of information about a research or development project. Typically reports have to meet criteria of clarity and conciseness for general consumption. In a Convergence Technique program an additional criterion is imposed: the report must provide the information demanded by the criteria stated for that program activity under which it was supported.

APPENDIX D

VITAE OF PARTICIPANTS

The materials which follow present summaries of the vitae of the individuals involved in this project. Three different groups were constituted with some overlap of personnel for that reason the composition of the different groups is stated below and the vitae which follow are listed in alphabetical order.

Planning team number one

John Ertl, University of Ottawa
Nicholas Fattu, Indiana University
Monte Penney, U.S. Office of Education
Robert C. Remstad, University of Wisconsin-Milwaukee
Donald E. P. Smith, University of Michigan
Edward G. Summers, Indiana University
Willavene Wolf, Ohio State University
William J. Gephart, Phi Delta Kappa

Reading definition conference

John R. Bormuth, University of Chicago
Sara W. Lundsteen, University of Texas
Monte Penney, U.S. Office of Education
Alton L. Raygor, University of Minnesota
Helen M. Robinson, University of Chicago
Edward G. Summers, Indiana University
Wendell Weaver, University of Georgia
William J. Gephart, Phi Delta Kappa

Planning team number two

Nicholas Fattu, Indiana University
Monte Penney, U.S. Office of Education
Roger Sisson, University of Pennsylvania
Walter Stolz, University of Texas
Edward G. Summers, University of British Columbia

VITAE SUMMARIES

John R. Bormuth:

Personal data: Born September 1928 in Garrett, Indiana; Married and father of three children.

Education: Bachelors degree from Manchester College (Indiana) 1953; Masters and doctorate from Indiana University 1959 and 1962 respectively.

Work experiences: Public school teaching and administration 1955-61; UCLA 1962-66, University of Minnesota 1966-67, and University of Chicago 1967 to present.

Professional focus and contributions: Active in research on reading with a focus on readability research, Dr. Bormuth has been the principal investigator in three projects funded by the U.S.O.E. He has been an active member of the International Reading Association and the National Council of Teachers of English and has participated on committees in both organizations. He is an Advisory Editor for the Reading Research Quarterly and has authored numerous articles on the reading process and on criteria of readability.

John Ertl:

Personal data: Born in 1933 in Budapest, Hungary.

Education: Secondary education in England; Bachelors from Carleton University (Ottawa, Canada) 1959; Masters and doctorate from the University of Ottawa 1961 and 1966 respectively.

Work experiences: Teaching experience in psychology at the University of Ottawa; Research and administrative experience in the Center for Cybernetic Studies which he directs.

Professional focus and contributions: Dr. Ertl's research has concentrated on the relationship between the electrical activity of the brain and intelligence. He has been the principal investigator on projects funded by the U.S. Office of Education, the Ontario Mental Health Foundation, and the Ford Foundation.

Nicholas Fattu:

Education: Bachelors and masters degrees, University of Idaho; Doctorate, University of Minnesota.

Work experiences: Teacher of mathematics at the Junior College level in Minnesota; Statistician, Committee on Institutional Research and lecturer in mathematics University of Minnesota; Research psychologist, Office of Scientific Research, NDRC Project N106 and Educational Testing Service; Associate professor of psychology, Michigan State University; Chief, Job Proficiency Analysis Division, Human Resources Research Center, USAF: Director, Institute of Educational Research and professor, Indiana Univeristy.

Professional focus and contributions: Dr. Fattu has contributed to the field of educational research through an extensive list of journal articles, bulletins, and monographs and through the development of 72 published proficiency tests. His work has focused on the methods of research with emphasis on analysis procedures and measurement. His study of cognitive processes is also extensive. In his role as Director of the Institute of Educational Research he has consulted with and assisted others in research on many aspects of education. He has been an active participant in the American Psychological Association, the American Educational Research Association, Institute of Mathematical Statistics, Association for Computing Machinery, and the Operations Research Society of America. He is a Fellow in the American Association for the Advancement of Science.

Sara W. Lundsteen:

Education: Bachelors and masters degrees from Southern Methodist University and Doctorate from the University of California, Berkeley. Studied also at the Sorbonne in Paris and the University of Copenhagen.

Work experiences: Assistant professor at the University of California, Santa Barbara and Associate professor at the University of Texas

Professional focus and contributions: Dr. Lundsteen's work has concentrated on language arts and reading. She has taught graduate courses in these areas, served as the principal investigator on grants from the Charles F. Kettering Foundation and the U.S.

Office of Education. These efforts and her many publications concentrate on the areas of listening, reading, and problem solving. Her work has produced curriculum materials and measurement procedures on children's thinking in the language arts that have been tested in schools in California.

Monte Penney:

Personal data: Born in 1940 in Washington D.C.; Married and the father of one child.

Education: Bachelors degree in English literature with concentrations in secondary education and psychology, University of Virginia 1962. Graduate work in English literature, George Washington University.

Work experiences: Administrative experience as a commissioned officer U.S. Army; editorial and administrative experience with a Washington, D.C. newspaper; Research Associate National Center for Educational Research and Development, USOE.

Professional focus and contributions: Mr. Penney is a student of the research management process. He has written or co-authored several articles on research programing and is a member of several USOE Advisory Boards.

Alton L. Raygor:

Personal data: Born November 1922 in Erie, Pennsylvania; Married and father of three children.

Education: Bachelors degree University of Toledo, 1948; Masters and doctorate University of Michigan 1951 and 1957 respectively.

Work experiences: Teaching experience in the fields of history, educational psychology, and reading; administrative and research experiences in the Reading and Study Skills Center, University of Minnesota. Visiting lectureships at six major institutions.

Professional focus and contributions: Dr. Raygor has contributed to understanding adult reading through extensive research and writing, through service on four editorial advisory boards, through active participation and leadership in the International

Reading Association and the National Reading Conference, and through teaching and advising graduate students at the University of Minnesota.

Robert C. Remstad:

Personal data: Born March 1928 in Kenosha Wisconsin; Married and father of three children.

Education: Bachelors, masters and doctorate University of Wisconsin, 1951, 1957, and 1968 respectively.

Work experiences: Teaching and counseling experience in secondary schools in Wisconsin and the American Dependent Schools in Japan. Fellow in Experimental Design, University of Wisconsin, Assistant and Associate professorships at the University of Wisconsin-Milwaukee.

Professional focus and contributions: Dr. Remstad is a specialist in research methodology and has written numerous articles on this area. He has worked with numerous researchers as a methodological consultant and has presented numerous papers at meetings of the American Educational Research Association and the National Council on Measurement in Education.

Helen M. Robinson:

Education: Bachelors, Ohio University 1926; Masters, Ohio State Univeristy 1927; and doctorate, University of Chicago 1944.

Work experiences: Director Bureau of Special Education, Ohio State Department of Education; Superintendent and psychologist in the Orthogenic School, University of Chicago; Director of the Reading Clinic, University of Chicago; William S. Gray Research Professor of Reading, University of Chicago; and Director of the Reading Research Center, University of Chicago; currently Professor Emeritus, University of Chicago.

Professional focus and contributions: Dr. Robinson has been a continuing contributor to the understanding of reading and reading instruction. She has written numerous articles and books in this area and has been the principal investigator in many research studies on reading. For several years she has carried on the study initiated by William S. Gray which has produced annual summaries of research

done on reading. Dr. Robinson has provided leadership in numerous professional organizations including a term as President of the National Conference on Research in English.

Roger L. Sisson:

Personal data: Born June 1926; Married and father of four children.

Education: Bachelors and masters degrees, Massachusetts Institute of Technology, 1948 and 1950 respectively.

Work experiences: Manager of Systems Department for Aeronutronic, a division of the Ford Motor Company; Senior Scientist with Auerbach Corporation; Associate professor of operations research and statistics, University of Pennsylvania; and, private consultant in systems analysis.

Professional focus and experiences: Mr. Sisson has concentrated on problems of business management, systems applications in business and education, and computer applications in these areas. He has numerous publications in these areas. Currently he is self-employed as a consultant in systems analysis.

Donald E. P. Smith:

Education: Bachelors, Univeristy of Rochester 1948; Masters and doctorate, Cornell University 1949 and 1952 respectively.

Work experiences: Teaching in public schools in New York and at the University of Michigan where he is currently Professor of Education and Chief, Division of Reading Improvement.

Professional focus and contributions: Dr. Smith is a regular consultant to the Center for Research on Language and Language Behavior and the Center for Programmed Learning both at Michigan. His research has concentrated on reading, reading disabilities and language arts. He has published articles and reports on this work and has devoted the past several years to the development of programs for teaching reading. He is an active member of the American Psychological Association, The American Educational Research Association and the American Association for

the Advancement of Sciences. Recently he was asked to serve on the Commissioner's National Advisory Committee on Dyslexia.

Walter Stolz:

Personal data: Born, December 1938 in Milwaukee Wisconsin; Married and father of two children.

Education: Bachelors, masters, and doctorate, University of Wisconsin 1960, 1962, and 1964 respectively. Post doctoral NSF fellowship at the Center of Cognitive Studies, Harvard University.

Work experiences: Technical writer and programer with IBM; Research Assistant in the Wisconsin Mass Communication Research Center; Assistant Professor of Psychology, and Research Associate in the University of Texas Linguistic Research Center.

Professional focus and contributions: Dr. Stolz has written or co-authored numerous articles on linguistics and research design related to linguistics.

Edward G. Summers:

Personal data: Born September 1932 in Denver, Colorado; Married and father of four children.

Education: Bachelors, masters, and doctorate, University of Minnesota, 1958, 1960, and 1963 respectively.

Work experiences: Youth work in camps in Minnesota; Clinical fellowship in the Student Counseling Bureau of the University of Minnesota; Instructor in the Psychology Department of Ball State University; Assistant professor, University of Pittsburgh; Associate and full professorships at Indiana University; Professor University of British Columbia. While at Indiana University he was the director of The ERIC-CRIER.

Professional focus and contributions: Dr. Summers has concentrated his research on the nature of the reading process and the teaching of reading. His work as director of the ERIC Clearinghouse on Reading has created a valuable resource for the field of reading. He has published extensively with a focus on the information that exists in the literature in the field. He has also served as editor of the Reading Research Quarterly.

Wendell Weaver:

Personal data: Born November 1925; Married and father of seven children.

Education: Bachelors, Oglethorpe College 1950; Masters, Emory University 1957; and doctorate, University of Georgia 1961.

Work experiences: Teaching experiences at the elementary level, in English and mathematics at the secondary level, and as a guidance counselor; Teaching at the collegiate level at Campbell College and at the University where he now holds the rank of full professor.

Professional focus and contributions: Dr. Weaver has concentrated his work and numerous publications on the psychology of language and on reading. He has conducted investigations on the Cloze Procedure and information sources in reading. He is currently completing a three year study on the relation of oral language and reading. He has been active in the American Psychological Association, American Educational Research Association, the International Reading Association, and the National Reading Conference. He is President-Elect of the latter group.

Willavene Wolf:

Education: Bachelors, Rio Grande College 1954; Masters and doctorate, State University of Iowa 1957 and 1960 respectively.

Work experiences: Teacher of English in secondary school; Supervisor of Clinicians, Iowa Remedial Reading Clinic; Assistant, associate, and full professorships at Ohio State University.

Professional focus and contributions: Dr. Wolf has conducted several U.S.O.E. research projects focused on eyemovements and critical reading skills. Her publications are numerous and contribute to the understanding of perception, eyemovement patterns, and the nature of critical reading, as well as on the preparation of teachers. While at Ohio State University she served in a role that assisted faculty members in the planning of research projects. She has also contibuted as a consultant to regional

laboratories and R&D centers. Her teaching has included courses in the psychology of reading, educational psychology, and research methodology.

William J. Gephart:

Personal data: Born December 1928; Married and father of two children.

Education: Bachelors and masters degrees, Wayne State University 1953 and 1959 respectively; Doctorate Ohio State University 1965.

Work experiences: Teaching at the secondary level in the areas of physics, mathematics, and speech; counseling and administrative experience at the secondary level; counselor practicum supervisor, Ohio State University; Director of Research, University of Wisconsin-Milwaukee; and Director of Research Services Phi Delta Kappa.

Professional focus and contributions: Dr. Gephart has concentrated his study on the nature of the research process and the education of research personnel in education. He has been the principal investigator on two U.S.O.E. research projects and has contributed significantly to two others. His publications include books and articles that focus on the nature of research education. For the past six years he has been studying procedures for evaluating the methodological adequacy of completed research. In that time he has developed two instruments for assessing research quality and accumulated 38 samples of similar work. He is a founder and Co-Director of the annual National Symposium for Professors of Educational Research, a founder and first Chairman of the American Educational Research Association Special Interest Group: Professors of Educational Research, and a member of the AERA Task Force on Research Training.

APPENDIX E

INTERIM REPORT TO THE OFFICE OF EDUCATION

ROGER L. JOHNSON.....President
Kansas State College
Pittsburg, Kansas 66762

J. W. LEE.....Vice President
P. O. Box 186, Mississippi College
Clinton, Mississippi 39056

G. R. CHILDS.....Director
518 Nebraska Hall, University of Nebraska
Lincoln, Nebraska 68508

HOWARD M. SOULE.....Director
328 West Clarendon
Phoenix, Arizona 85021

A. GARLAND HARDY.....Director
Ball State University
Muncie, Indiana 47306

PHI DELTA KAPPA

A professional education fraternity connected with approved colleges and universities of graduate rank maintaining schools, colleges, or departments of education

International Headquarters Building
EIGHTH AND UNION, BLOOMINGTON, INDIANA 47401
Telephone 812-339-1156

MAYNARD BEMIS
Executive Secretary

ROBERT E. McDANIEL
Director of Administrative Services

STANLEY ELAM
Editor

MAURICE F. SHADLEY
Director of Special Services

WILLIAM J. GEPHART
Director of Research Services

EDWARD C. WEIR
Associate Editor

October 23, 1969

TO: Dr. James E. Allen, Jr., United States Commissioner of Education, Department of Health Education and Welfare.

FROM: William J. Gephart, Director of Research Services, Phi Delta Kappa & Principal Investigator, CRP Project No. 8-0737 "Application of the Convergence Technique to Basic Studies of Reading."

RE: Recommendations for Program of Research & Development for Reading.

On behalf of the members of the Planning Team in the above named project, I propose the following recommendations and urge their adoption.

1. THE PROGRAM PLAN PROPOSED IN THE REPORT OF THIS PROJECT (AND SUMMARIZED HEREIN) SHOULD BE IMPLEMENTED AS SOON AS ORGANIZATIONAL AND BUDGETARY ARRANGEMENTS CAN BE MADE WITHIN THE OFFICE OF EDUCATION.
2. THREE PROJECTS PROPOSED IN THE PLAN ARE SO VITAL TO THE ATTAINMENT OF FUNCTIONAL READING COMPETENCE (EITHER THROUGH THE PROPOSED PROGRAM OR ANY OTHER EFFORT WITH THE SAME GENERAL GOAL) THAT THEY SHOULD BE INITIATED IMMEDIATELY THROUGH THE USOE BUREAU OF RESEARCH.
3. THE CONVERGENCE TECHNIQUE SHOULD BE USED IN FUTURE PROGRAMATIC EFFORTS OF THE OFFICE OF EDUCATION.

The material which follows summarizes the program plan and provides detail and rationale for the three recommendations above.

A PROGRAM OF READING AND DEVELOPMENT FOR READING

There is currently dissatisfaction with the failure of American education to develop reading skills. That dissatisfaction has two elements: first, the current system fails with too large a number; and second, even in those with which the current system is effective there are inefficiencies and inadequacies. Despite the lack of sound empirical evidence to substantiate these criticisms, one thing is certain. Our society demands improvement in the system.

Concurrent with the demand for improvement in reading instruction, scientists indicate that there is much that is not known about (1) the reading process, (2) the manner in which individuals learn to read, and (3) effective ways of instructing individuals to learn.

Given this demand for improvement and lack of knowledge about the phenomena central to the problem, an integrated research and development program is required for the attainment of a goal of functional reading competence on the part of all citizens. Through the application of the Convergence Technique (a research planning and management procedure) the details of such a program have been evolved. The overall nature of that program is displayed in Figure 1. and a brief description of its elements are presented below. A more detailed explication is being prepared for the Final Report of CRP Project No. 8-0737.

OVERALL NATURE OF THE RESEARCH AND DEVELOPMENT FOR READING PROGRAM

The field of reading has two assets on which this program is based. First, the literature on the field presents models of the reading process,

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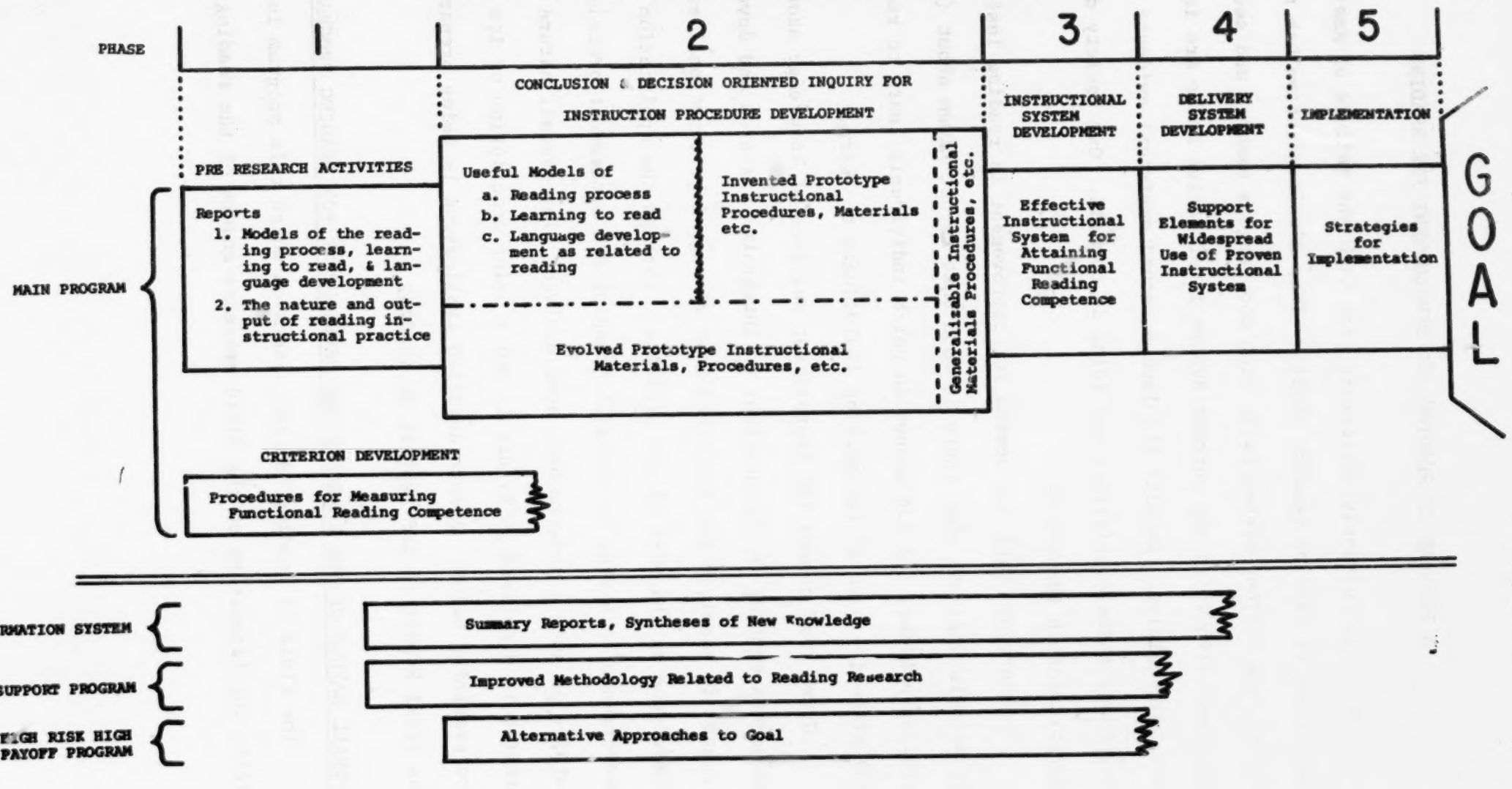
PHASE PRODUCT BLOCK DIAGRAM


PHASE
1
2
3
4
5
CONCLUSION & DECISION ORIENTED INQUIRY FOR INSTRUCTION PROCEDURE DEVELOPMENT
INSTRUCTIONAL SYSTEM DEVELOPMENT
DELIVERY SYSTEM DEVELOPMENT
IMPLEMENTATION
GOAL
PRE RESEARCH ACTIVITIES
Useful Models of
a. Reading process
b. Learning to read
c. Language development as related to reading
Invented Prototype Instructional Procedures, Materials etc.
Generalizable Instructional Materials Procedures, etc.
Effective Instructional System for Attaining Functional Reading Competence
Support Elements for Widespread Use of Proven Instructional System
Strategies for Implementation
MAIN PROGRAM
Reports
1. Models of the reading process, learning to read, & language development
2. The nature and output of reading instructional practice
Evolved Prototype Instructional Materials, Procedures, etc.
CRITERION DEVELOPMENT
Procedures for Measuring Functional Reading Competence
INFORMATION SYSTEM
Summary Reports, Syntheses of New Knowledge
SUPPORT PROGRAM
Improved Methodology Related to Reading Research
HIGH RISK HIGH PAYOFF PROGRAM
Alternative Approaches to Goal

the process of learning to read, and of reading instruction. Some of these models have been subjected to empirical tests and have been at least partially confirmed. Second, large numbers of children learn to read as they move through schools.

The R & D for Reading Program assumes that by becoming more systematic in model development and in instructional system development functional reading competence can be attained by all. The combination of the program plan presented on these pages and continued application of the Convergence Technique management procedures should make work on model and instructional system development more systematic and efficient than it has been in the past.

The R & D for Reading Program involves:

(1) the identification of existing models of the reading, learning to read, and reading instruction processes;

(2) further refinement, development and empirical confirmation of existing models of the reading and learning to read processes to the point at which they facilitate accurate explanation and prediction of reading behaviors and thus become useful bases for engineering instructional materials and procedures;

(3) concurrent and systematic adaptation of instructional programs by experimentation designed to reduce the discrepancy between reading instruction objectives and outcomes;

(4) the conduct of independent confirmations to assess the communicability, effectiveness, and robustness of prototype materials, procedures equipment, etc.;

(5) the design and testing of an instructional system which incorporates the effective items (referred to in (4) above) into an instructional system capable of achieving the program objective of functional reading competence;

(6) the design and testing of a delivery system, the supportive materials, procedures, etc., necessary to ensure effective use of a proven instructional system; and

(7) design of implementation stratigies.

PROGRAM GOAL

The goal stated for the program is 100 PERCENT OF ALL PEOPLE (NOT IN PERMANENT CARE INSTITUTIONS) OVER 10 YEARS OF AGE CAN COMPLETE 90 PER CENT OF A SET OF TASKS WHICH EXEMPLIFY READING BEHAVIORS. It is assumed that competence in reading is a multi-dimensional variable. The tasks referred to in the program objective above indicate a specific level of competence. It is further assumed that that level cannot now be specified. (Note: one element of the Program Plan is criterion development.)

PATHS TO ATTAINMENT OF THE PROGRAM GOAL

It is likely that the path to the attainment of the program goal will continue to remain primarily within formal education institutions. (As a contrast, it is unlikely that the program goal will be attained through a process of chemical innoculation.) Within the educational system there are two alternative paths to the goal. These are the pro and con of the assumption, development of any instructional system requires advanced knowledge about what is to be taught.

When applied to the teaching of reading, this assumption on one hand (pro), asks for advances in our understanding of the following different phenomena:

1. The reading process;
2. The process of learning to read;
3. Reading skills as related to the child's level of language development; and
4. Reading instruction.

On the other hand (con), it asks for manipulation of practices in reading instruction in ways which correct the current failures in the system.

These two paths are displayed in Phase 2 of Figure 1. That block is divided horizontally with the activities above the line representing the expansion of knowledge by research which develops models (representations) of the phenomena involved PRIOR to the invention of instructional materials, procedures and programs. Below the horizontal line are activities which involve: (1) the operation of selected instructional programs; (2) examination of the discrepancy between the operationally defined objectives related to functional reading competence and the actual output of the instructional program; (3) the determination of procedures for reducing that discrepancy; (4) the modification of the ongoing program; and (5) recycling until the criterion of the overall program is satisfied.

Both of these paths terminate with the creation of prototype instructional materials, or procedures that work in the hands of their creator in achieving some part of the goal. One more activity is involved in Phase 2, the independent confirmation of the effectiveness

of these prototype items. This latter activity makes two contributions. It assures that the instructional system is communicable. It speaks to its applicability in different settings. Both of these conditions must be met before program success can be assumed and thus are criteria for determining success in achieving this subobjective of the R & D for Reading Program.

INSTRUCTIONAL SYSTEM DEVELOPMENT

Achievement of the program goal requires the systematic assembly of an effective instructional system out of elements that have been proven effective in achieving this or that part of the goal.

DELIVERY OF AN INSTRUCTIONAL SYSTEM

The development of an effective instructional system is not a sufficient accomplishment for attaining the program goal. The American educational system has thousands of autonomous subsystems, which vary in potential for implementation of an instructional system. To avoid (as much as possible) misapplication of that effective instructional system a variety of supportive elements have to be developed and tested. The subgoal of this work is the provision of the procedures and materials which will enable schools and teachers to effectively implement the instructional system.

IMPLEMENTATION

In a system comprised of thousands of autonomous subsystems, assuring implementation is difficult. Educational changes have occured through several strategies in the past (legislation, proven effectiveness of

programs, gradual evolution of social values, etc.) Until the details of ways of attaining the program goal and the political and social climate of the times are clear, specific steps toward implementation cannot be specified. It is clear though, that alternative strategies must be examined for their potential utility. Work of this sort is anticipated in Phase 4.

PRERESEARCH ACTIVITIES

The volume of literature on the phenomena involved in this program is large. To date syntheses of it have not been accomplished in a manner which delineates a state-of-the-art. At the same time there is little in the way of sound statistical evidence on how reading is being taught and on the level of reading achievement in the United States. For these reasons the program includes in Phase 1. a search and synthesis of two kinds of literature. The first of these is designed to identify and consolidate knowledge of: (1) the existing models of phenomena central to the programatic effort; (2) the assumptions which underly the relevant research; (3) the empirically based facts that provide either detail for a model or, which are outside of any existing model; and (4) hypotheses about the phenomena which need to be tested (again either in support of a model or external to all models).

The preresearch survey of instructional practice will synthesize information from the literuature on numbers of students who succeed and fail to learn to read, the amount and nature of the effort that goes into the teaching of reading. These two literature syntheses provide the structure necessary to detail the activities in Phase 2. The report on

models will specify research that is needed in their further development while the survey of instructional practice will identify the most promising reading instruction approaches as foci for adaptive experimentation.

OTHER PROGRAM ELEMENTS

Plans for the program contain three additional elements. The first of these is an Information System, an information storage and retrieval system which takes over where the literature search and synthesis effort terminates. Along with this continued synthesis and reporting activity the information system must store for generated data for further use. It must also serve as a dynamic information dissemination effort so that program managers, project personnel, and the lay public can be quickly apprized of new developments resulting from work within or outside the program.

The Program Plan shows a Support Program element. Included in this element are projects which, although not absolutely required in the Main Program, will improve its progress. (Example: Methods currently exist for diagnosing some types of reading difficulties. A better method for these diagnoses might improve the performance of an Adaptive Experimental Laboratory. Such a methodological improvement activity would be considered as a part of the Support Program.)

The final program element, the High Risk-High Payoff Program is reserved for research and/or development that is based on a logic different from that which structures the main program. (Example: A research program that explores the development of a pill which makes a

reader out of a non-reader would be found in this High Risk-High Payoff Program.) If such an approach withstands a test of empirical adequacy and can be made economically, the logic underlying the entire program must be examined and changed in light of such newly generated information.

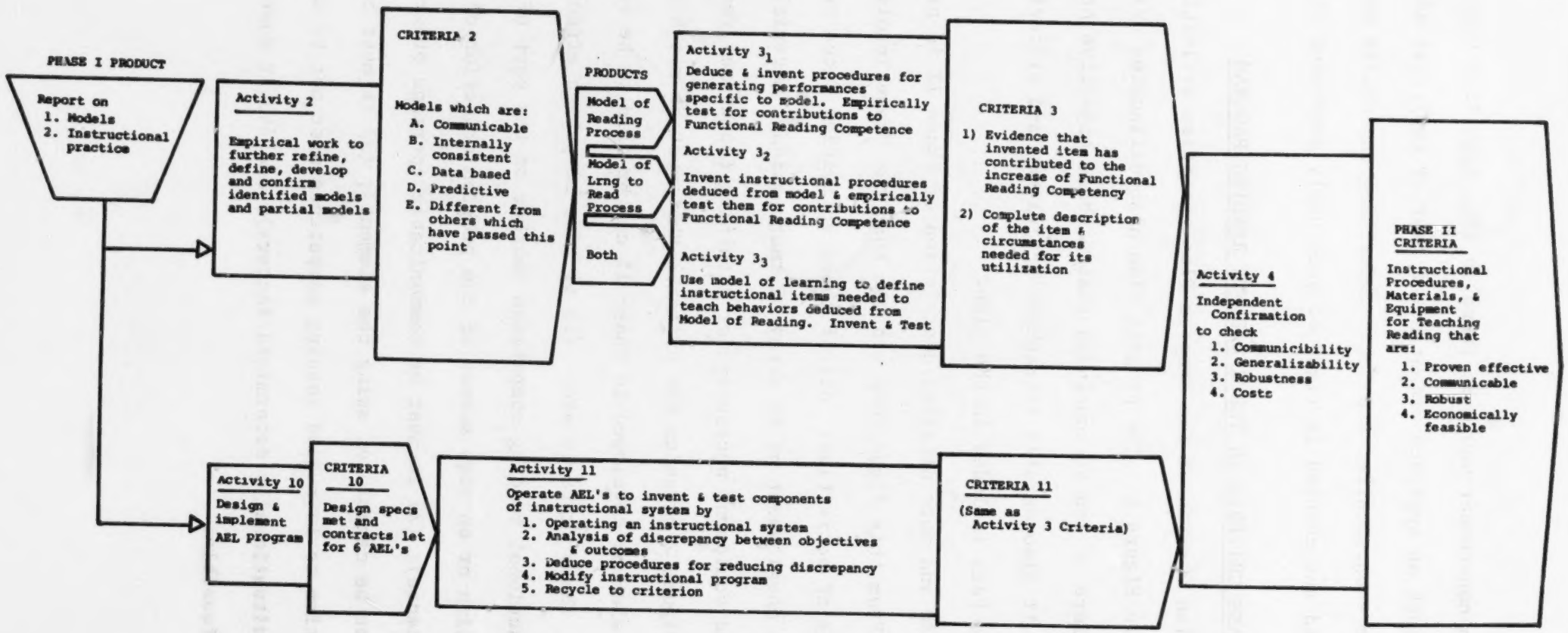
THE ROLE OF PHASE CRITERIA IN THE R & D FOR READING PROGRAM

The detailed version of the Program Plan specifies activities shown in each phase in Figure 1. The program Plan also delineates criteria which must be met before it can be concluded that a phase objective has been accomplished. It also details intraphase activities and criteria where they have been included in the plan.

An expanded and more detailed description of Phase II is presented in Figure 2. From this figure one can see that the Phase involves five different types of activities. All of these activities focus on the Phase objective, the development of an array of instructional materials, procedures, and equipment necessary for attaining functional reading competence. Figure 2 presents the criteria that must be met before an instructional element developed in Phase II can be said to be ready for further work. Those criteria are: (1) it must be proven effective in increasing functional reading competence (either on the part of a subset of the population or on some subset of the program criterion of functional reading competence); (2) it must be communicable (persons other than the originator must be capable of using the element); (3) it must be robust (its contribution to increased reading competence must not be modified by variation of situationally determined factors); and (4) it must be economically feasible.

THE TARGETED RESEARCH & DEVELOPMENT PROGRAM FOR READING - TRDPR

PHASE 2--SUBOBJECTIVES & CRITERIA


PHASE I PRODUCT
Report on
1. Models
2. Instructional practice
Activity 2
Empirical work to further refine, define, develop and confirm identified models and partial models
CRITERIA 2
Models which are:
A. Communicable
B. Internally consistent
C. Data based
D. Predictive
E. Different from others which have passed this point
PRODUCTS
Model of Reading Process
Model of Lrng to Read Process
Both
Activity 3₁
Deduce & invent procedures for generating performances specific to model. Empirically test for contributions to Functional Reading Competence
Activity 3₂
Invent instructional procedures deduced from model & empirically test them for contributions to Functional Reading Competence
Activity 3₃
Use model of learning to define instructional items needed to teach behaviors deduced from Model of Reading. Invent & Test
CRITERIA 3
1) Evidence that invented item has contributed to the increase of Functional Reading Competency
2) Complete description of the item & circumstances needed for its utilization
Activity 4
Independent Confirmation
to check
1. Communicibility
2. Generalizability
3. Robustness
4. Costs
PHASE II CRITERIA
Instructional Procedures, Materials, & Equipment for Teaching Reading that are:
1. Proven effective
2. Communicable
3. Robust
4. Economically feasible
Activity 10
Design & implement AEL program
CRITERIA 10
Design specs met and contracts let for 6 AEL's
Activity 11
Operate AEL's to invent & test components of instructional system by
1. Operating an instructional system
2. Analysis of discrepancy between objectives & outcomes
3. Deduce procedures for reducing discrepancy
4. Modify instructional program
5. Recycle to criterion
CRITERIA 11
(Same as Activity 3 Criteria)

Meeting these criteria requires two things. First, prototype instructional items must be designed, developed, and used in a manner which substantiates their potential. Second, these prototypes must be subjected to confirmation tests by individuals other than their inventor. Activity 4 in Figure 2 represents the independent confirmation. Activities 2-3 and 10-11 are alternative (and probably complementary) paths for the development of data based prototype instructional materials, procedures, or equipment. The criteria that must be met in each of these activities are shown in Figure 2.

One final point, as the program progresses data and information are generated. The logic of the programatic effort must be examined in juxtaposition with the newly created knowledge. If that new knowledge conflicts with the logic of the Program Plan, another planning team is to be convened and a new plan developed. In this manner the entire program becomes a self correcting system, one which will eventually converge on the program goal.

RECOMMENDATIONS AND SUPPORTING STATEMENTS

Recommendation 1. THE PROGRAM PLAN PROPOSED IN THE REPORT OF THIS PROJECT (AND SUMMARIZED HEREIN) SHOULD BE IMPLEMENTED AS SOON AS ORGANIZATIONAL AND BUDGETARY ARRANGEMENTS CAN BE MADE WITHIN THE OFFICE OF EDUCATION.

This recommendation is based on the following.

1. Previous attempts to improve reading through research and development have been little more than a loose collection of independent projects whose contributions cannot easily be accumulated.

2. The Convergence Technique, used in the development of this plan, is a research program planning and management procedure that has proven to be effective with programatic efforts in the biomedical field. It was designed for the express purpose of integrating numerous individual projects into a program for attaining some specified goal.

3. The details of the proposed program have been developed through an extensive effort of an interdisciplinary team.

4. Examiniation of the program by a variety of experts has failed to uncover flaws in the logic or omitted programatic elements.

Acceptance of this recommendation will require numerous actions within the Office of Education. The Planning Team has listed four which are of critical importance to the conduct of the proposed program. They are:

1. Pursuit of the program must continue to employ the procedures of the Convergence Technique. As indicated the technique is designed for program planning and management. Thus far the technique has been used and found beneficial in planning the program. Details of the plan and its implementation assume the utilization of the technique in the management of the program.

2. An individual must be named whose full time assignment is to function as the program manager. For the initiation of this program the full time attention of an individual with competence in research design and research administration is required. As the program advances the number of individual projects underway will require a staff for project monitoring, project development, and program evaluation. At that point the work of the program must be coordinated by one individual.

3. This programatic effort toward attainment of the goal should be integrated into the Office of Education organizational structure at the Branch level or its equivalent. The program needs a span of time and level of antonomy in funding decisions that is equivalent to what now exists at the Branch level in OE. Further, this status displays the importance of the program to the profession and to others which might relate to it.

4. Funding for this programatic effort should be sought as a line item in future appropriations under ESEA Title IV. The details of the program do not require legislation beyond what has already been passed by Congress. Identification of it as a line item will establish it as a continuing OE effort, provide budgetary security, and ensure evaluation and reportage on program progress.

Recommendation 2. THREE PROJECTS PROPOSED IN THE PLAN ARE SO VITAL TO THE IMPROVEMENT OF READING ACHIEVEMENT (EITHER THROUGH THE PROPOSED PROGRAM OR ANY OTHER EFFORT WITH THE SAME GENERAL GOAL) THAT THEY SHOULD BE INITIATED IMMEDIATELY THROUGH THE USOE BUREAU OF RESEARCH.

The three projects recommended above are:

1. A literature search, analysis, evaluation and synthesis on phenomena in the reading process, learning to read, and language development related to reading. The product of this effort would be a report which identifies, describes and distinguishes between:

   a. Models or partial models of these phenomena (Similar models will be synthesized).
   b. Assumptions underlying this research.
   c. Empirically established facts that either fit within a model or are external to all models.
   d. Hypotheses which need to be tested (again either within or external to models).

2. A search, analysis, evaluation and synthesis of literature and existing survey data on the level of reading achievement and the nature of the instructional effort. The product of this effort would be baseline data on:

   a. Level of reading skill development.

b. Instructional practice including:

1) time spent
2) procedures employed
3) materials used

c. Amount and character of manpower and resources expended in reading instruction.

3. Development of a criterion measure for assessing reading achievement which is predictive of performance on the reading tasks encountered in our culture.

The current state-of-the-art in reading is such that these three projects are necessary for either this or any other programatic attempt to increase reading.

There is much literature available on phenomena related to increasing functional reading competence. This literature has been catalogued and physically accumulated into a bibliography of approximately 8,000 items. It has not been accumulated in terms of what is known about reading and related topics. To generate such a state-of-the-art synthesis requires: systematic analysis of the contents of this literature; cataloguing of its component contributions; evaluation of the methodological adequacy of each empirically based conclusion; syntheses of the acceptable facts and relationships into general models and partial models; and specification of empirical work which must be undertaken to further develop identified models and to prove or disprove them as potential bases for instructional practice.

Arguments in support of the literature search for models and facts on reading and related phenomena center on the assumption that to improve the way a topic is taught one should first understand that topic. Reading instruction has seldom been based on or improved through deductions from a model of what reading is.

A recently published book has undertaken a part of the literature search on practice and has been generally accepted as a boost to the field. That job needs to be expanded to cover the items listed in 2a, b, & c above before the nature of the problem can be made explicit.

Finally, existing measures of reading competence are almost all designed to display an individual's relative position among some reference group. They do not give information on how fast an individual can read what material with what level of comprehension. The few that do tend in this direction have not been established as predictors of reading tasks found in our culture.

Recommendation 3. THE CONVERGENCE TECHNIQUE SHOULD BE USED IN FUTURE PROGRAMATIC EFFORTS IN THE OFFICE OF EDUCATION.

The program plan described in these materials came to be through, first, the establishment of a program goal, and second the planning aspect of the Convergence Technique. The recommendation above suggests that the Office of Education continue to engage in and expand its goal setting activities. Such a stance would assist the agency to help Congress in the formation of legislation, and for the implementation and management of legislated programs. It is believed that society will benefit from such goal setting followed by systematic development and operation of programatic efforts though the procedures of the Convergence Technique.

As indicated earlier these recommendations are made after trying only part of the Convergence Technique, the planning session. The participants in the CT spend 4 to 6 weeks on nearly full time planning. This can be contrasted with two or three day planning sessions or those that last

one or two hours weekly for many weeks. Neither of these latter approaches facilitates planning as has been experienced in the Convergence Technique project. It is believed that, although this type of planning is more expensive, in this case about $30,000 per team, its effectiveness will in the long run make it more economical than those sessions that spend $1 to $2 thousand.

APPENDIX F

PROFILING COMPLETED RESEARCH

The evaluation of the quality of completed research in education has two distinct components. The first of these components is the problem attacked in the study. The second is the methodological adequacy of the study conducted. Profiling, the procedure described in this paper, deals with the latter, the evaluation of the methodological adequacy. It avoids evaluation of the problem itself on the belief that the importance of a given problem can only be established through an historical perspective. To assert otherwise would imply the existence of a preferred value system.

Evaluation of methodological adequacy of a given piece of research is a prerequiste for the acceptance or rejection of the conclusions of that investigation. Such conclusions can be no stronger than the methods utilized in generating and analyzing the data on which the conclusion is reached. In the past we have operated on the assumption: if the methodology is sound, the conclusion can be accepted and vice versa. The faultiness of this assumption is one of the problems that have long plagued both the improvement of and use of educational research.

Research methodology is multifaceted. It involves an inherent logical argument, the selection of subjects to be studied, structuring of experiences for those subjects, measurement, and the analysis of the generated data. It is possible to have sound procedures in some of these facets and weak procedures in other; a possibility that precludes a statement that a conclusion is based either on sound or unsound methods.

The problem is further complicated. Needs for surety in varying items and professional circumstances set the quality standard for research methods. If the need for knowledge in an area is great, the methodological development crude, and the amount of risk to personal safety low, conclusions can be accepted and operated on despite weaknesses in their methodological base. In another set of circumstances this would be wholly unacceptable. Since the use to which a conclusion might be put cannot be controlled, an absolute level of quality cannot be established for each research effort.

Regardless of the knowledge needs or professional circumstances, a given conclusion ought not to be accepted, held tentatively or rejected without evaluation of the research methods underlying it. It is asserted the the profiling procedure described in this paper will facilitate the labeling of the methodology of completed research reports. When this labeling has been completed,

the user of that study can make sounder decisions regarding the acceptance or rejection of its conclusions.

ELEMENTS IN PROFILING

In conducting an empirical study an investigator does numerous things. Those things are the elements on which the profiling activity focuses. They include: (1) the structuring of a logical argument; (2) the generation of data; and (3) the analysis of that data. All three items are involved in investigations which test hypotheses while only items two and three are used in studies which attempt to answer empirical questions.

THE INHERENT LOGICAL ARGUMENT is of crucial importance when study attempts a test of a hypothesis. In effect, the investigator is trying to determine the truth or falsity of his hypothesis. He does this through a logical argument described by Polya.[1] It consists of a major premise, one or more minor premises, and a conclusion.

The major premise is typically a statement which asserts, "If the _____ _____ hypothesis is a true statement; then _____ _____ events will be observed as indicators of that truth." An example of a major premise can be seen in a study reported a few years ago by McNeil.[2] He proposes a hypothesis which asserts that teachers present different instructional treatments for the two sexes of their students. As indicators of the truth of that statement he reasoned that boys would be nominated more often than girls as recipients of certain kinds of teacher action. His major premise could be stated as,

> If the hypothesis (teachers provide different instructional treatment for boys than they do for girls) is a true statement; then systematic differences by sex will be seen when children are asked to name the students who receive specified teacher treatments.

Two kinds of minor premises have been evolved from Polya's work by Raths.[3] The first of these deals with the predicted observation. Was it or was it not seen? The premise's exact nature in a given study is determined after the data are analyzed. In the McNeil example used above, significant differences by sex were observed. The minor premise in that case would be, "There is a systematic sex differentiation in the nominations."

The second category of minor premises deals with rival hypotheses, rival or alternative explanations for the observation reported in the first minor premise. The premise is based upon the recognition that an effect in the social sciences often has multiple causes. Once an observation has been made, all its possible causes must be examined before it can be concluded that

the observation supports the truth of a specific hypothesis. One of three general conditions might exist ranging from no rival hypotheses are apparent to rival hypotheses may exist to rival hypotheses are definitely involved.

The final element of the logical argument is the conclusion. Its form in a given study is dependent upon the nature of the two minor premises. From the first minor premise comes information as to whether or not the truth of the hypothesis being tested is supported. If the consequents predicted are observed, support for the truth of the hypothesis is presented. If the observation is not made, support cannot be claimed. (Note: Failure to make the predicted observation does not automatically mean rejection of the hypothesis.) The second minor premise determines the strength of the conclusion. If rival hypotheses are known to be present, very weak support for the truth of the hypothesis has been developed. If there is the possibility but not the probability of rival hypotheses, tentative support is generated. And finally, if no rival hypotheses are conceiveable, it is credible that the hypothesis is a true statement.

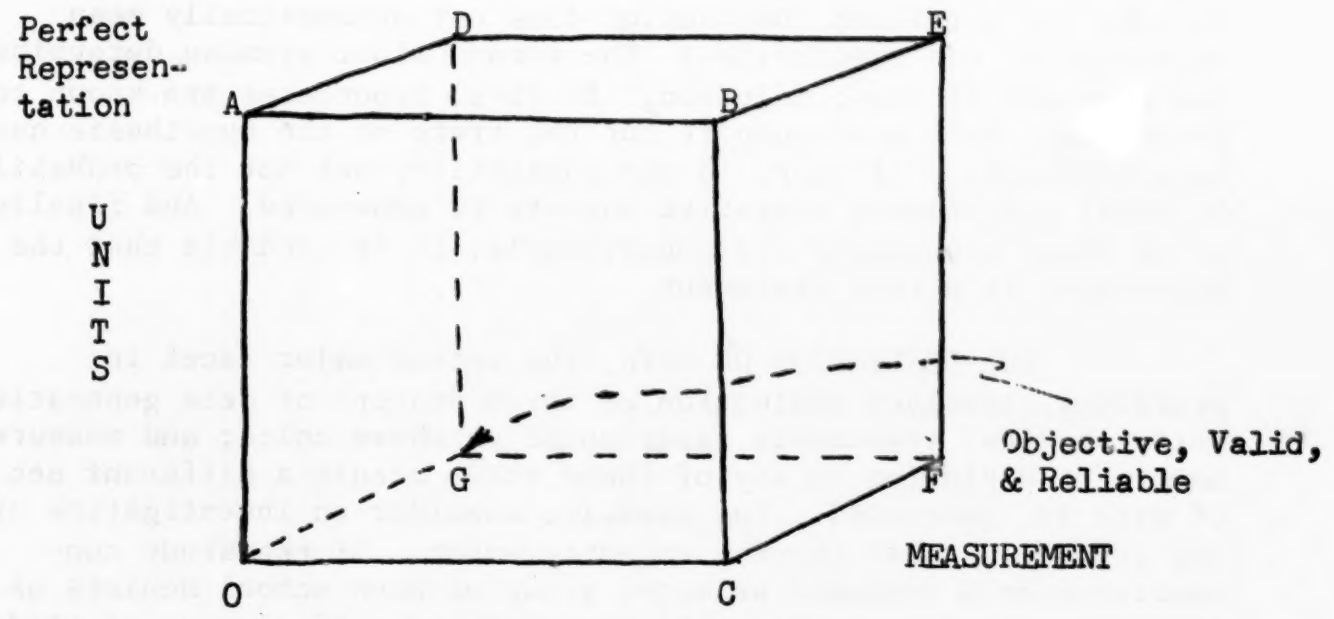
THE GENERATION OF DATA, the second major facet in profiling, involves evaluation of three aspects of data generation: units studies; treatments experienced by those units; and measurement. If variation in any of these three occurs a different set of data is generated. For example, consider an investigation of the effects of test anxiety on achievement. If the study concentrates on a randomly selected group of high school seniors as subjects, one set of data will be generated. If a group of students who are divergent on a measure of test anxiety is selected as subjects, a different set of data will be generated. Given a specifi[illegible] group as subjects, variation in the treatment or of their experiences will cause different sets of data to be generated. Again the test anxiety problem provides an example. One set of data could be generated by a treatment in which the subjects are given information about the importance of a test and administered a test that is constructed for students at a much higher level of education than are the subjects. Still a different set of data will be generated if the students are repeatedly given a test that is very difficult. If the effects of a specific treatment on a specific group are measured by a paper and pencil test such as Sarazon's Test of Test Anziety, one set of data would be generated. On the other hand if the seats in the classroom were wired and a galvanic skin response measure were taken, quite a different set of data would be generated.

These three aspects of data generation are displayed graphically in Figure 1.[4] The scale of unit quality or representativeness runs along the dimension OA, treatment quality OC, and measurement quality OG. A project which selected a sample perfectly representative of a population of interest would be located at Point A. on the cube. If, in that same study, a thorough programing

of the content and sequence of the treatments was employed in generating data, the project would be conceptualized as being at Point B. on the quality cube. Finally, if our study employed perfectly objective, valid, and reliable measuring techniques, it would be located at Point E. on the cube.

FIGURE 1.

THE RESEARCH QUALITY CUBE



A given study seldom reaches this level of data generation quality. Rather it falls somewhere between the extremes. To facilitate profiling ordinal scales have been developed for these three dimensions as shown below.

Dimensions for the Research Quality Cube

Representativeness

R_5 = The entire population was studied
R_4 = Random selection from a specified population was employed to determine which units were studied
R_3 = Purposive sampling from a specified population established the group studied
R_2 = Volunteers were studied
R_1 = An unidentified group of subjects was studied

Treatment

T_6 = A theoretically based treatment was administered and described and controls were employed for mediating variables identified in the theory AND for variables extraneous to the theory that might have an effect.

T_5 = Same as T_6 with the exception of the lack of controls for extraneous variables.

T_4 = Same as T_6 with the exception of the lack of controls for theory encompassed mediating variables and extraneous variables.

T_3 = No theory stated but the employed treatment described in detail sufficient for replication.

T_2 = Commonly known treatment administered but not described in detail.

T_1 = Something of an undescribed nature was experienced by the units studied.

Measurement

M_5 = Data were generated through the use of either a commercially standardized or ad hoc instrument AND data are presented which establish high validity and reliability for its use in this measurement task.

M_4 = Data generated through the use of a commercially standardized instrument and evidence presented indicating moderate validity and reliability for this application.

M_3 = Data generated through a commercially standardized test but no evidence presented as to its validity and reliability for this application.

M_2 = Data generated through an ad hoc instrument and evidence of moderate validity and reliability presented.

M_1 = Data generated through an ad hoc instrument with either no supporting evidence as to validity and reliability or evidence indicating poor validity and reliability on either a commercially standardized or ad hoc instrument.

DATA ANALYSIS PROCEDURES are the final element in profiling. When data, typically in the form of numbers, are generated as the supporting evidence for a conclusion, understanding of the meaning of those numbers is incumbent upon the researcher and the research utilizer. That meaning is not readily apparent if there is a large quantity of numbers. Simplifying procedures have been developed; procedures which are not appropriate for all kinds of data.

The determination of the correct procedure in a given study is not an exact science. In developing a procedural flow chart for the profiling of educational research, sixteen schemes

were identified which were supposed to assist in the selection of the correct statistic for given sets of data. Some of these were incomplete schemes in that they purported to deal only with limited kinds of statistical analysis.[5] Some imply a comprehensiveness but fail to be definitive as they list a number of statistics appropriate for a given set of conditions.[6]

Since a single comprehensive grid or table for selecting the correct analytic procedure could not be found a second task was undertaken. Existing statistical procedures were catalogued and the assumptions underlying them were listed. An effort to build a comprehensive selection procedure by analyzing these items has to this point been unsuccessful. (A colleague at Indiana University[7] has just recently attacked this problem using Guttman's Facet Design and Analysis Technique[8] with initially promising results.)

Because of these problems three grids have been generated for profiling the data analysis procedures. The first of these deals with analytic procedures for sample description. It includes measures of central tendency and dispersion and classifies the procedures by levels of measurement, i.e., nominal, ordinal, and interval-ratio. The second grid is used when an associational analysis is desired. It has identical labels for its rows and columns which refer to the nature of the measurement on the two variables to be correlated. The categories in this case are:

1. Continuous variables (age, height, I.Q., achievement, etc.)
2. Forced dichotomy (number of persons over and under 100 I.Q., number of persons weighing over and under 150 pounds, etc.)
3. True dichotomy (student-nonstudent, male-female, etc.)

Given the nature of the two variables on which an associational analysis is desired the grid can be used to select the appropriate statistic. Four special cases exist and are shown with the grid. Three of these are instances in which more than two variables are involved. The final case covers correlation among ordinal variables.

The third grid deals with inferential statistics, instances in which a generalizaiton about the relationship between the numbers generated by observation of some sample are indicative of observations that could be made on the entire population. The categorizing elements on this grid are the number of dependent and independent variables, the level of measurement, and the number of groups. Again the determination of the appropriate level on each category for a given set of data leads to the recommended statistic.

The use of these grids leads to a specific statistic (in the inference grid there is the possibility of alternatives). Through the article the analytic procedure actually used can be

identified. Two quality categories follow from a comparison of the statistic used and the statistic appropriate for the data and prupose of the study: first, the statistic used is identical with the statistic identified as appropriate; second, they are different. In the former the research is profiled as appropriately analyzed; in the latter, as inappropriately analyzed.

PROFILING SUMMARIZED: When a study has been analyzed and profiled, it has been described on the following basis:

A. Is it (1) a test of a hypothesis, or (2) an answer to an empirical question?

A_1. If it is a test of a hypothesis, is the strength of conclusions: I The hypothesis is very little more credible; II more credible; or III very much more credible?

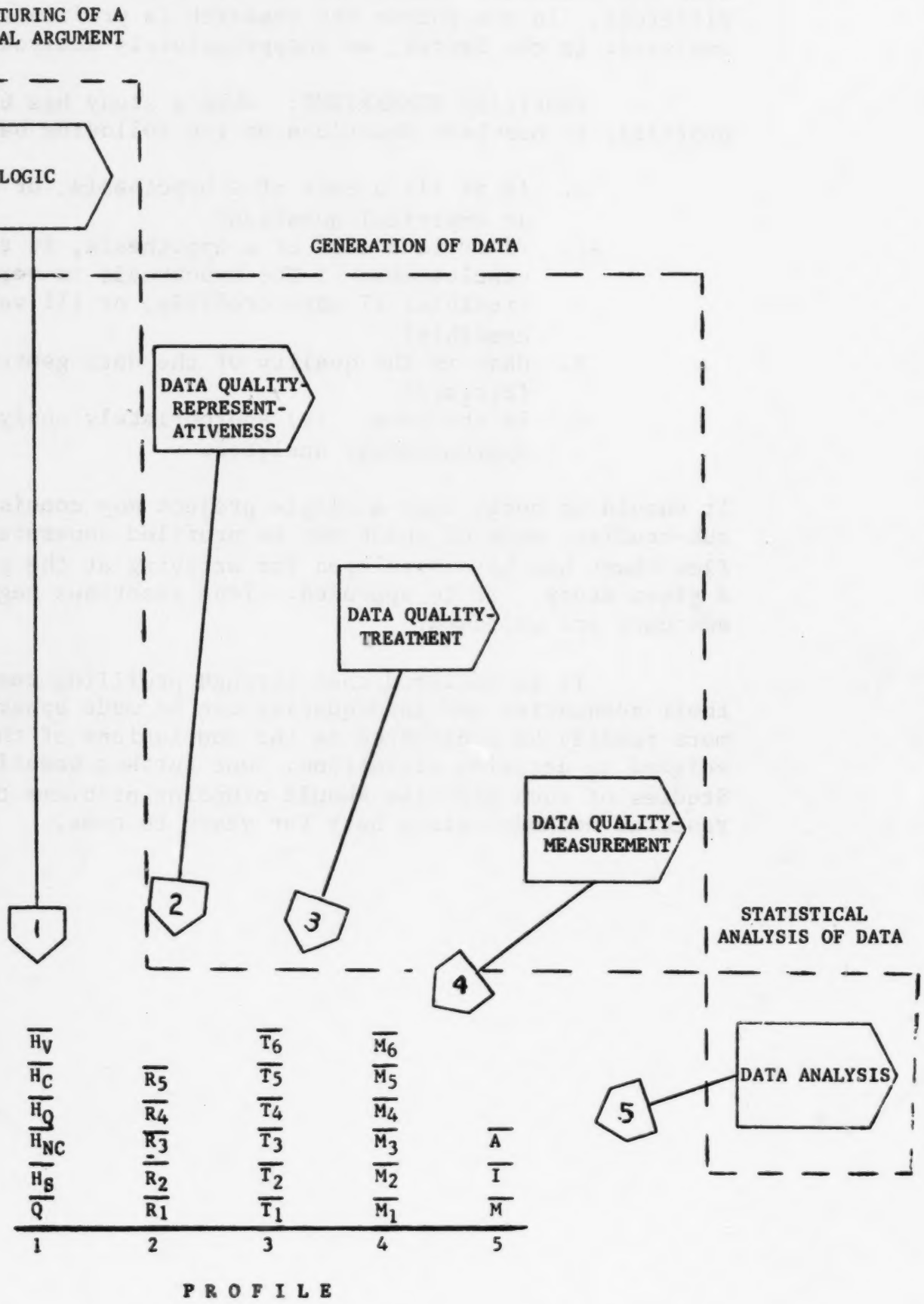
B. What is the quality of the data generation procedure ($r_i t_i m_i$)?

C. Is the data: (a) appropriately analyzed; or (b) inappropriately analyzed.

It should be noted that a single project may consist of several sub-studies, each of which may be profiled separately. A decisional flow chart has been developed for arriving at the profile for a given study. It is appended. Your reactions regarding its adequacy are welcomed.

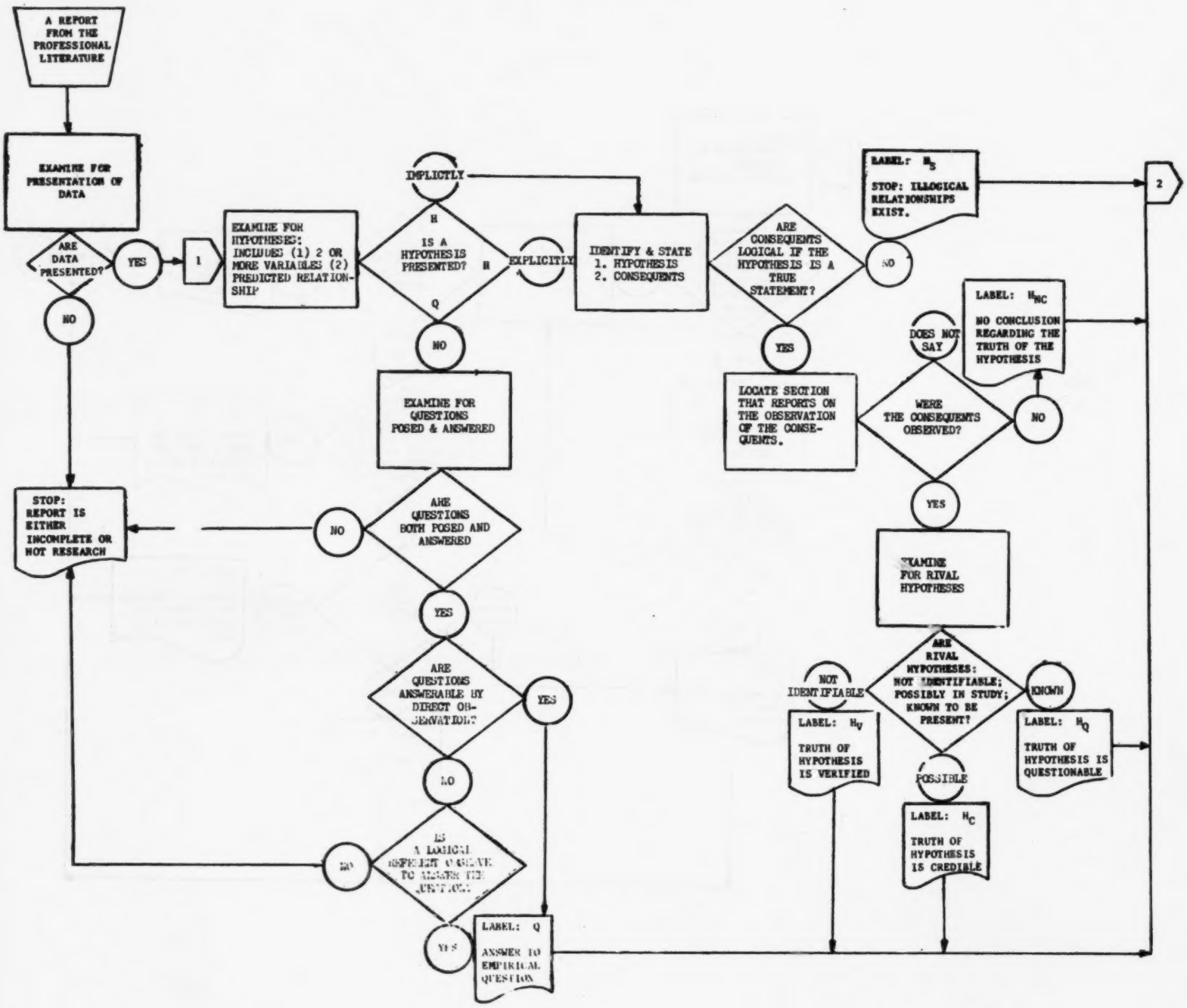
It is believed that through profiling completed research their adequacies and inadequacies can be made apparent and can more readily be considered as the conclusions of the research are weighed in decision situations. One further benefit is seen. Studies of such profiles should pinpoint problems that could keep research methodologists busy for years to come.

FACETS OF THE RESEARCH PROCESS



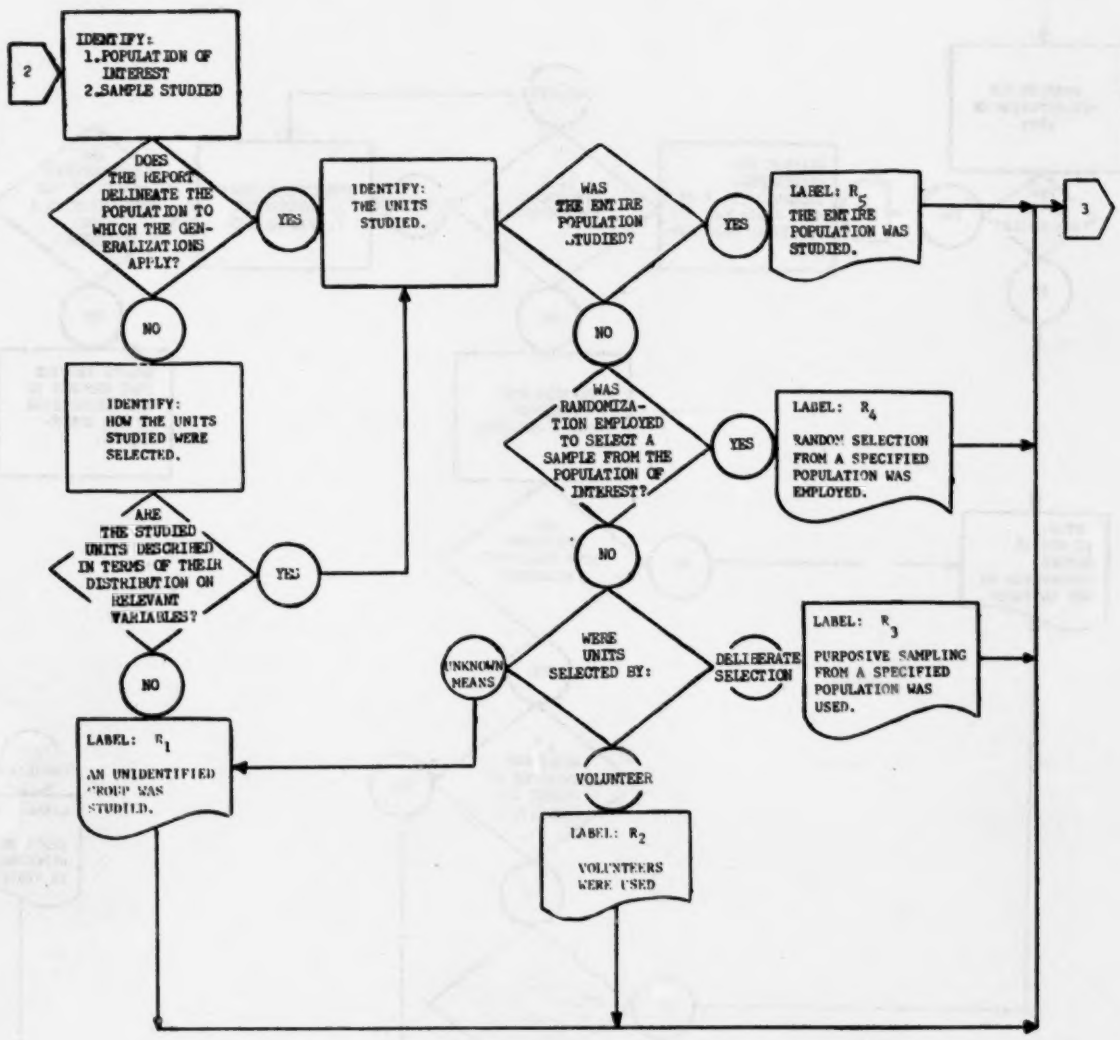
RESEARCH PROFILING FLOW CHART

LOGIC



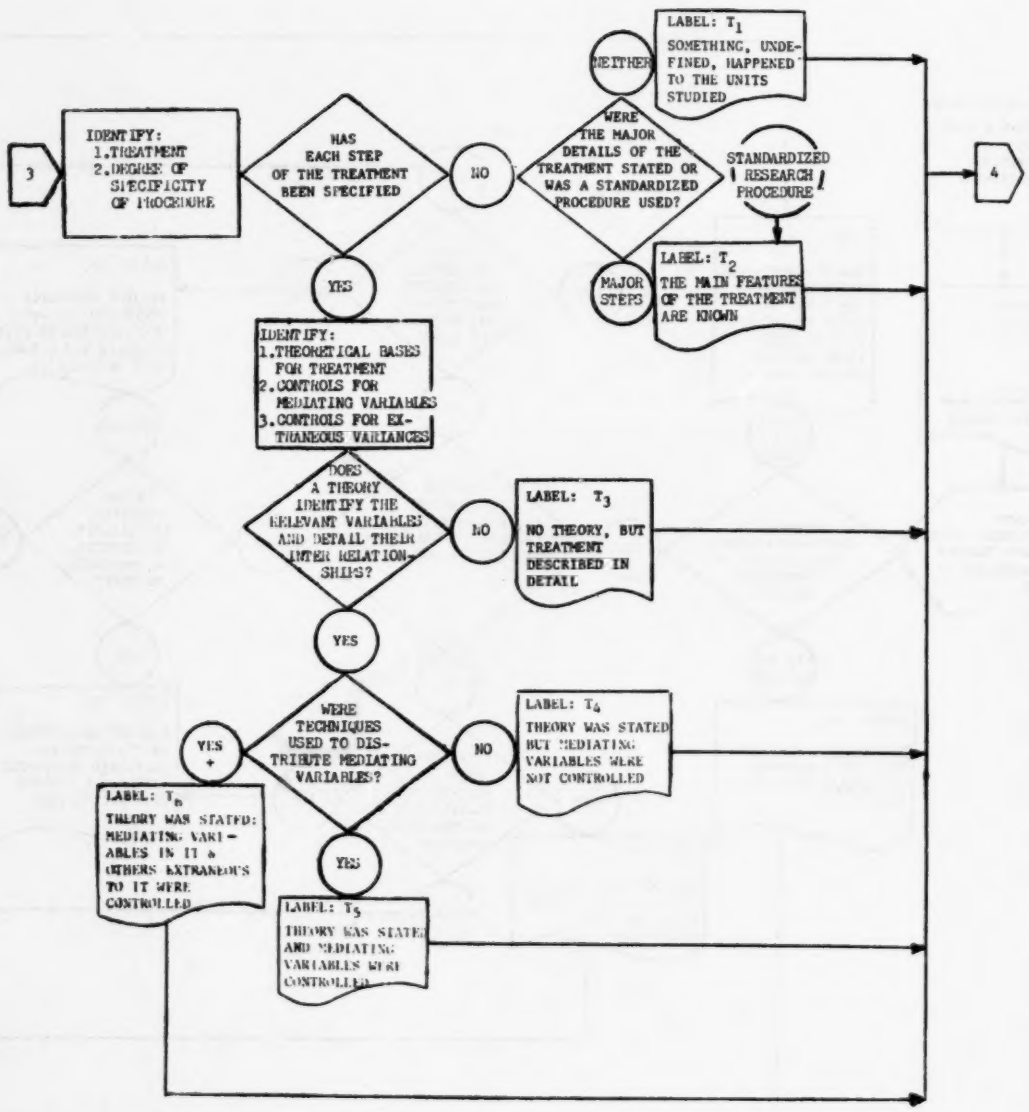
RESEARCH PROFILING FLOW CHART

DATA QUALITY - REPRESENTATIVENESS


2
IDENTIFY:
1.POPULATION OF INTEREST
2.SAMPLE STUDIED
DOES THE REPORT DELINEATE THE POPULATION TO WHICH THE GENERALIZATIONS APPLY?
YES
NO
IDENTIFY: THE UNITS STUDIED.
WAS THE ENTIRE POPULATION STUDIED?
YES
LABEL: R5 THE ENTIRE POPULATION WAS STUDIED.
3
NO
IDENTIFY: HOW THE UNITS STUDIED WERE SELECTED.
ARE THE STUDIED UNITS DESCRIBED IN TERMS OF THEIR DISTRIBUTION ON RELEVANT VARIABLES?
YES
NO
LABEL: R1 AN UNIDENTIFIED GROUP WAS STUDIED.
WAS RANDOMIZATION EMPLOYED TO SELECT A SAMPLE FROM THE POPULATION OF INTEREST?
YES
LABEL: R4 RANDOM SELECTION FROM A SPECIFIED POPULATION WAS EMPLOYED.
NO
WERE UNITS SELECTED BY:
UNKNOWN MEANS
DELIBERATE SELECTION
LABEL: R3 PURPOSIVE SAMPLING FROM A SPECIFIED POPULATION WAS USED.
VOLUNTEER
LABEL: R2 VOLUNTEERS WERE USED

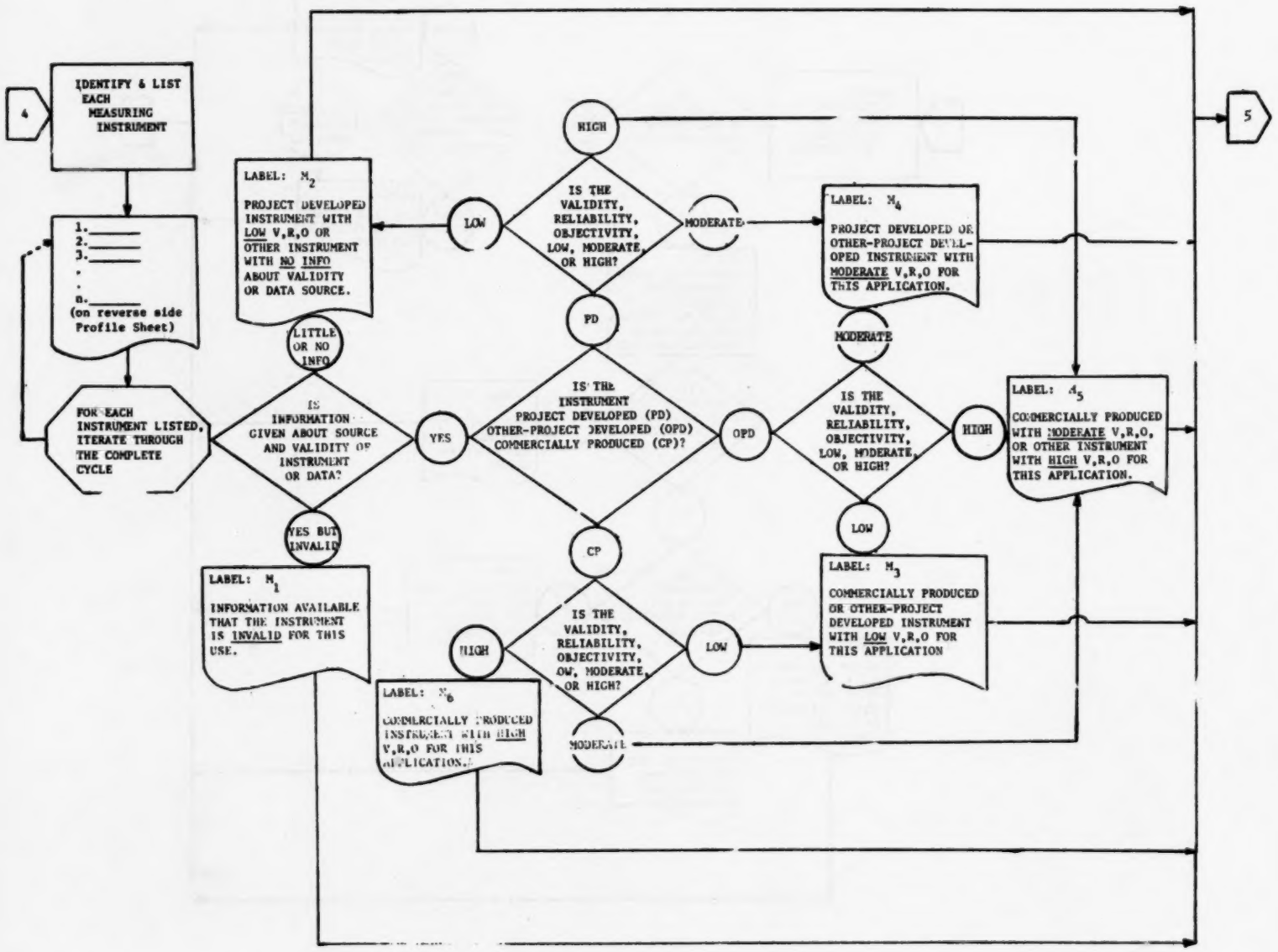
RESEARCH PROFILING FLOW CHART

DATA QUALITY - TREATMENT



RESEARCH PROFILING FLOW CHART

DATA QUALITY - MEASUREMENT


4
IDENTIFY & LIST EACH MEASURING INSTRUMENT
1.
2.
3.
.
.
n.
(on reverse side Profile Sheet)
FOR EACH INSTRUMENT LISTED, ITERATE THROUGH THE COMPLETE CYCLE
IS INFORMATION GIVEN ABOUT SOURCE AND VALIDITY OF INSTRUMENT OR DATA?
LITTLE OR NO INFO
YES
YES BUT INVALID
LABEL: M1
INFORMATION AVAILABLE THAT THE INSTRUMENT IS INVALID FOR THIS USE.
IS THE INSTRUMENT PROJECT DEVELOPED (PD) OTHER-PROJECT DEVELOPED (OPD) COMMERCIALLY PRODUCED (CP)?
PD
OPD
CP
IS THE VALIDITY, RELIABILITY, OBJECTIVITY, LOW, MODERATE, OR HIGH?
LOW
MODERATE
HIGH
LABEL: M2
PROJECT DEVELOPED INSTRUMENT WITH LOW V,R,O OR OTHER INSTRUMENT WITH NO INFO ABOUT VALIDITY OR DATA SOURCE.
LABEL: M4
PROJECT DEVELOPED OR OTHER-PROJECT DEVELOPED INSTRUMENT WITH MODERATE V,R,O FOR THIS APPLICATION.
LABEL: M3
COMMERCIALLY PRODUCED OR OTHER-PROJECT DEVELOPED INSTRUMENT WITH LOW V,R,O FOR THIS APPLICATION
LABEL: M5
COMMERCIALLY PRODUCED WITH MODERATE V,R,O, OR OTHER INSTRUMENT WITH HIGH V,R,O FOR THIS APPLICATION.
LABEL: M6
COMMERCIALLY PRODUCED INSTRUMENT WITH HIGH V,R,O FOR THIS APPLICATION.
5

RESEARCH PROFILING FLOW CHART

ANALYSIS

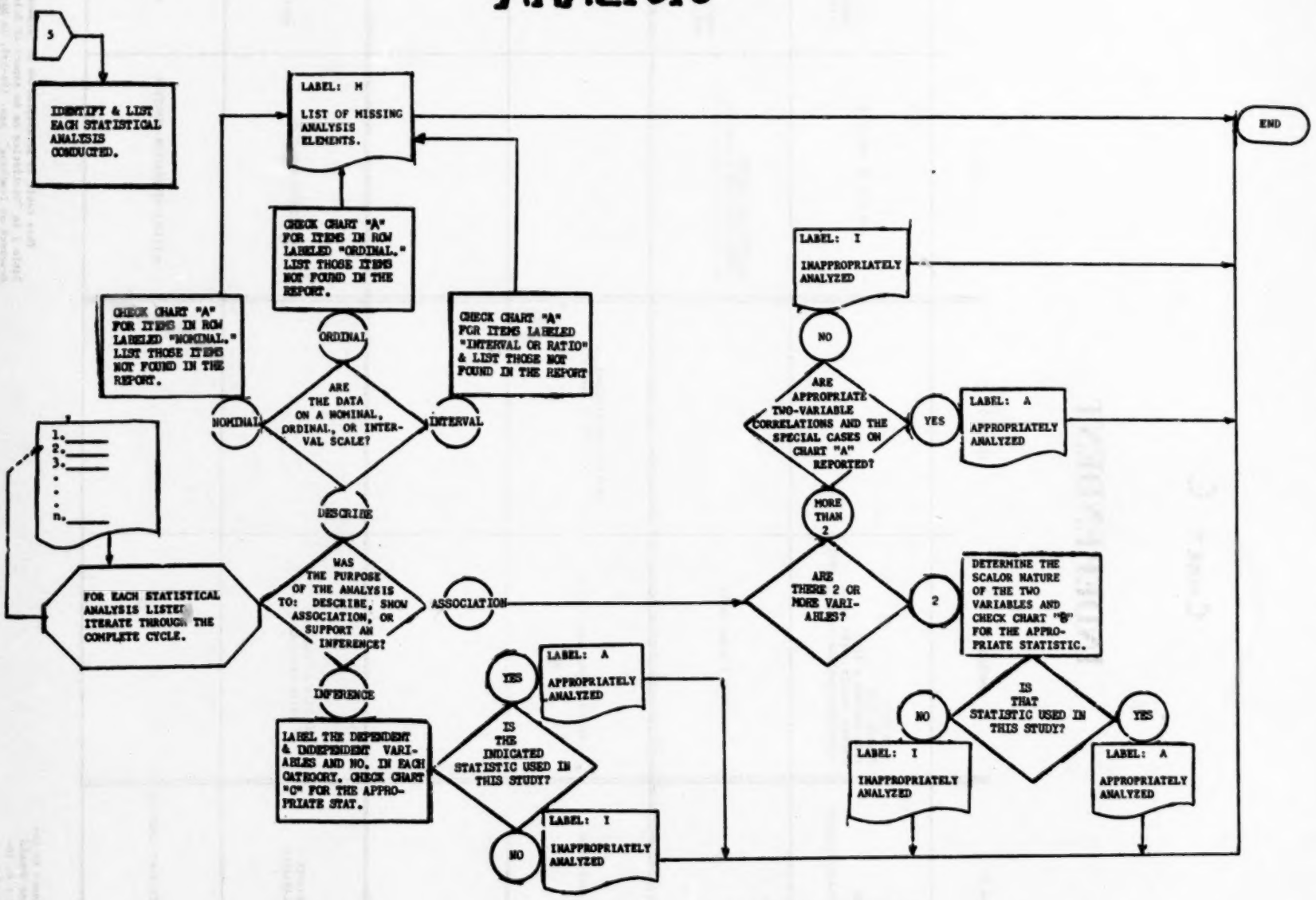

5
IDENTIFY & LIST EACH STATISTICAL ANALYSIS CONDUCTED.
LABEL: M
LIST OF MISSING ANALYSIS ELEMENTS.
END
CHECK CHART "A" FOR ITEMS IN ROW LABELED "ORDINAL." LIST THOSE ITEMS NOT FOUND IN THE REPORT.
CHECK CHART "A" FOR ITEMS IN ROW LABELED "NOMINAL." LIST THOSE ITEMS NOT FOUND IN THE REPORT.
CHECK CHART "A" FOR ITEMS LABELED "INTERVAL OR RATIO" & LIST THOSE NOT FOUND IN THE REPORT
ORDINAL
NOMINAL
INTERVAL
ARE THE DATA ON A NOMINAL, ORDINAL, OR INTERVAL SCALE?
1.
2.
3.
.
.
.
n.
DESCRIBE
WAS THE PURPOSE OF THE ANALYSIS TO: DESCRIBE, SHOW ASSOCIATION, OR SUPPORT AN INFERENCE?
ASSOCIATION
INFERENCE
FOR EACH STATISTICAL ANALYSIS LISTED ITERATE THROUGH THE COMPLETE CYCLE.
LABEL THE DEPENDENT & INDEPENDENT VARIABLES AND NO. IN EACH CATEGORY. CHECK CHART "C" FOR THE APPROPRIATE STAT.
IS THE INDICATED STATISTIC USED IN THIS STUDY?
YES
NO
LABEL: A
APPROPRIATELY ANALYZED
LABEL: I
INAPPROPRIATELY ANALYZED
LABEL: I
INAPPROPRIATELY ANALYZED
NO
ARE APPROPRIATE TWO-VARIABLE CORRELATIONS AND THE SPECIAL CASES ON CHART "A" REPORTED?
YES
LABEL: A
APPROPRIATELY ANALYZED
MORE THAN 2
ARE THERE 2 OR MORE VARIABLES?
2
DETERMINE THE SCALOR NATURE OF THE TWO VARIABLES AND CHECK CHART "B" FOR THE APPROPRIATE STATISTIC.
IS THAT STATISTIC USED IN THIS STUDY?
NO
YES
LABEL: I
INAPPROPRIATELY ANALYZED
LABEL: A
APPROPRIATELY ANALYZED

CHART A

POPULATION DESCRIPTORS

	DISTRIBUTION	CENTRAL TENDENCY	DISPERSION
NOMINAL	FREQUENCY IN EACH CATEGORY	MODE	
ORDINAL	FREQUENCY IN EACH SCALOR POSITION	MEDIAN	SEMI-INTERQUARTILE RANGE
INTERVAL/ RATIO	FREQUENCY IN EACH INTERVAL	MEAN	STANDARD DEVIATION

CHART B - MEASURES OF ASSOCIATION

VARIABLE 2* \ VARIABLE 1*	CONTINUOUS	FORCED DICHOTOMY	DICHOTOMY
CONTINUOUS	PEARSON r	BISERIAL r	POINT BISERIAL r
FORCED DICHOTOMY	BISERIAL r	TETRACHORIC r	(NONE AVAILABLE USE CHI SQUARE)
DICHOTOMY	POINT BISERIAL r	NONE AVAILABLE	FOUR FOLD r OR PHI COEFFICIENT

* INTERVAL DATA

SPECIAL CASE
2 VARIABLES

RANK DATA SPEARMAN'S RHO

SPECIAL CASE
MORE THAN 2 VARIABLES

INTERVAL DATA MULTIPLE R
ORDINAL DATA KENDALL'S W
NOMINAL DATA CONTINGENCY COEFF. C

CHART C

INDEPENDENT

DEPENDENT

	NOMINAL 1	NOMINAL >1	ORDINAL 1	ORDINAL >1	INTERVAL 1	INTERVAL >1
NOMINAL 1	FISHER'S EXACT PROB. FOR 2x2 TABLE MC NEMAR'S TEST FOR SIGNIFICANCE OF CHANGES COCHRAN'S Q TEST FOR SEVERAL RELATED PROPORTIONS CHI-SQUARE TEST FOR INDEPENDENCE METHODS FOR MAXIMIZING PROBABILITY OF CORRECT CLASSIFICATION		SIGN TEST MEDIAN TEST MANN-WHITNEY U TEST KRUSKAL-WALLIS 1-WAY ANOVA KOLMOGOROV-SMIRNOV 1-SAMPLE TEST		ANALYSIS OF VARIANCE	HOTELLING'S T MAHALANOBIS' D^2 FISHER'S DISCRIMINANT FUNCTION
NOMINAL >1			FRIEDMAN'S 2-WAY ANOVA		ANALYSIS OF VARIANCE CORRELATION FACTOR ANALYSIS MULTIPLE DISCRIMINANT ANALYSIS	RAO'S V_h MULTIPLE DISCRIMINANT FUNCTION
ORDINAL 1	SIGN TEST MEDIAN TEST MANN-WHITNEY U TEST KRUSKAL-WALLIS 1-WAY ANOVA KOLMOGOROV-SMIRNOV 1-SAMPLE TEST	FRIEDMAN'S 2-WAY ANOVA	INDEX OF ORDER ASSOCIATION	ANALYSIS OF VARIANCE WITH TREND ANALYSIS		
ORDINAL >1						
INTERVAL 1	ANALYSIS OF VARIANCE	INDEPENDENT t ANALYSIS OF VARIANCE ANALYSIS OF COVARIANCE	ANALYSIS OF VARIANCE WITH TREND ANALYSIS		REGRESSION ANALYSIS	MULTIPLE REGRESSION ANALYSIS
INTERVAL >1	CORRELATION FACTOR ANALYSIS MULTIPLE DISCRIMINANT ANALYSIS MULTIPLE REGRESSION ANALYSIS	MULTIPLE DISCRIMINANT FUNCTION			MULTIPLE REGRESSION ANALYSIS	CANONICAL CORRELATION

Most of the measures shown are located with reference to the lowest order of data that should be used with them. One should always be able to transform the observed data downward i.e. interval can be considered ordinal or nominal, ordinal can be considered nominal.

This table is an adaptation of Tatsuoka and Tiedeman's Table 1 in "Statistics As An Aspect of Scientific Method in Research on Teaching" pgs. 154-155, in Handbook of Research on Teaching, N.L. Gage (Ed); Rand McNally, Chicago, 1963, 1218pp

RESEARCH PROFILE SHEET

H_v		T_6	M_6	
H_c	R_5	T_5	M_5	
H_q	R_4	T_4	M_4	
H_{nc}	R_3	T_3	M_3	A
H_s	R_2	T_2	M_2	I
Q	R_1	T_1	M_1	M
1	2	3	4	5

REPORT TITLE: _____

_____

AUTHOR _____ SOURCE: _____

___ STOP The report is either not research or it is an incomplete part of the research process.

1 LOGIC

___Q Answer to an Empirical Quation

Test of a Hypothesis

___H_s Stop, Illogical relationship.

___H_{nc} No concusion.

___H_q Hypothesis is questionable.
(Rival hypotheses must be considered a cause of the consequents)

___H_c Hypothesis is credible.
(Rival hypotheses may be considered a cause of the consequents)

___H_v Hypothesis is verified.
(Rival hypothese cannot be considered as a cause of the consequents)

2 DATA QUALITY - REPRESENTATIVENESS

___R_1 An unidentified group of subjects was studied.

___R_2 Volunteers were studied.

___R_3 Purposive sampling from a specified population established the group studied.

___R_4 Random selection form a specified population established the group studies.

___R_5 The entire population was studied.

3 DATA QUALITY - TREATMENT

___T_1 No theory; something undefiend happened to the units studied.

___T_2 No Theory; treatment description incomplete, or detailed elsewhere.

___T_3 No theory; treatment described in detail in the report.

___T_4 Theory stated but no controls on varibles.

___T_5 Theory stated and mediating variables controlled.

___T_6 Theory stated, mediating variables controlled, and techniques used to distribute possible extraneous variances.

4 DATA QUALITY - MEASURMENT

___M_1 Available information indicates instrument is invalid for this use.

___M_2 Project Developed instrument with low validity (V), reliability (R), ojbectivity (O), or other instrument with no info about validity or data source.

___M_3 Used Commercially Produced or Other-Project Developed instrument with low V,R,O for this application.

___M_4 Used Project Developed instrument or Other-Project Developed instrument with moderate V,R,O, for this application.

___M_5 Used instrument which was Project Developed with high V,R,O, or Other-Project developed with high V,R,O, or Commercially Produced with moderate V, R, O for this application.

___M_6 Used Commercially Produced instrument with high V,R,O for this application.

5 STATISTICAL ANALYSIS

___A Appropriately analyzed

___I Inappropriately analyzed

___M Missing items - incomplete analysis

FOOTNOTES

1. George Polya, Patterns of Plausible Inference: Mathematics and Plausible Reasoning Volume II, Princeton, New Jersey: Princeton University Press. 1954.

2. John McNeil, "Programed Instruction Versus Usual Classroom Procedures in Teaching Boys to Read." American Educational Research Journal 2:113-19; March, 1964.

3. James Raths, "Plasuible Logic in Educational Research" Paper delivered at AERA Convention, Feb. 1964. Reprinted in Educational Research: Selected Readings. W. J. Gephart & R. B. Ingle Eds., Columbus, Ohio: Charles E. Merrill, Publisher, 1969.

4. William J. Gephart and Robert B. Ingle, Educational Research: Selected Readings. Columbus, Ohio: Charles E. Merrill, Publisher, 1969.

5. See the grid on the inside cover of Siegel's Nonparametric Statistics, New York: McGraw-Hill Book Co., Inc. 1956. An unpublished paper presenting a grid of selecting the appropriate correlation coefficient developed by W. J. Gephart, the flow chart for analysis of variance in K. D. Hopkins & R. A. Chadbourn, "A Scheme for Proper Utilization of Multiple Comparisons in Research and a Case Study." American Educational Research Journal, 4:407-12, Nov. 1967.

6. See the grid presented by D. V. Tiedeman and M. Tatsuoka in Handbook of Research on Teaching. N. L. Gage Ed., Chicago: Rand McNally Publishers, 1963.

7. Donald Ary, Unpublished mimeo. Indiana University, Bloomington, Indiana, 1968

8. Described by Philip Runkle, "Some Recent Developments in Research Methodology." 1965 ERIC Document ED 010 221.

APPENDIX G

MAN-YEAR ESTIMATES FOR THE TARGETED RESEARCH AND DEVELOPMENT PROGRAM FOR READING

One of the activities engaged in by the planning team in detailing the Targeted Research and Development Program on Reading was an estimation of the time required in each subphase of the overall program plan. In these discussions two estimates were made: the number of professional man-years needed in each component of the program plan; and the number of calendary years that might be involved. When this was completed a program cost was estimated by multiplying the number of man-years of research and development time by $50,000 (a factor suggested by the Office of Education participant on the planning team based on funding experience in OE programs), adding the estimated administrative costs and survey costs identified in the program plan. The total figure was used in Chapter VII of this report as a basis for recommendations regarding organizational placement of the program within OE. The material which follows provides the basis for those figures.

PHASE I ACTIVITIES

Activity 1 and 2 (See the chart on p. 225) in this phase are literature search and syntheses that are designed to structure some of the activities in Phase II and to feed into the program information system. They will also contribute information valuable to efforts to improve reading instruction that are external to the Targeted Research and Development Program on Reading. For these reasons it is desirable that these efforts be completed by June 30, 1971 and thus the one year duration on the effort. There are in effect three subcomponents to each of these activities. The literature search on models (Activity 1) will prepare reports on models of: (1) the reading process; (2) the learning to read process; and (3) the development of language related to reading. The literature search on reading instruction practice will report on: (1) the nature of reading instruction, (2) the products of reading instruction; and (3) the training of personnel to provide this instruction. Because of the magnitude of the literature to be searched and the evaluative and synthesis efforts involved it was estimated that ten professional man-years were needed for each of these activities.

Activity 3 also has several components including: (1) the delineation and description of the subgroups which comprise the program's target population; (2) the identification of adult reading tasks to be used as the basis for the program criteria; and (3) the determination of resource ceilings within which instructional systems generated in the Targeted R&D Program on Reading must

TIME ESTIMATES FOR THE TRDPR

PHASE	ACTIVITY	NUMBER OF PROFESSIONAL MAN-YEARS OF WORK			ESTIMATED DURATION OF EFFORT
		TOTAL	USOE	OTHER	
I	1. Literature search and syntheses on models.	10	10	-	1
	2. Literature search and syntheses on instructional practice.	10	7	3	1
	3. Rationale and specifications for TRDPR criterion.	4	4	-	1
	* Administration of program	220	220	-	20
	Development of Information system	5	5	-	1
II	1. Model refinement and development research.	37	22	15	3.5
	2. Invention & Testing prototype instructional system components (Using Models).	75	45	30	4.5
	3. Invention & Testing of prototype instructional system components by adaptive experimentation (AEL's).	34	24	10	8
	4. Develop methodology for observing instructional practice.	6	3	3	1.5
	5. Develop and validate TRDPR criterion instrument (and administer).	7	4	3	1.5
	6. Independent confirmation of prototype instructional system components.	80	20	60	5
	** Operation of Information system	57	57	-	19
	Measurement and analysis personnel	10	10	-	16
III	Design and test complete instructional system	200	135	65	8.5
IV	Design and test delivery system	5100	100	5000	6.5
V	Design and prepare implementation strategies	3	3	-	1
	TOTALS	5858	669	5189	

* The figures in this row are administrative costs for the program given a program life of 20 years.
** The information system costs are figured on a program life of 19 years.

operate. Again, the program progress and progress of other work on reading is dependent upon the rapid development of a criterion instrument. Thus, this project has also been assigned a target duration of one year. The planning team estimated that the expenditure of four professional man-years would be necessary to complete this work in that time.

Two additional items must be attended to during the program's first year. These are the establishment of the program's administrative structure and its information system. The management structure proposed for this program (See Chapter VII, p. 80) sets offices of program improvement, program liaison, project development and monitoring, and information which would require a total staff of eleven. Given a twenty year program duration, 220 man-years of administration are needed. (This is a program total and thus does not appear under the remaining phases described below.) Establishment of the programs information system involves the specification of the operations to be assumed within that system, the construction of a dictionary-thesaurus as a base for the information system's operation, the identification of a contractor for the system, and the setting of a contract. Five man-years of effort are estimated for this work which is scheduled to be completed on a schedule paralleling the three activities described above.

PHASE II ACTIVITIES

It is estimated that the literature search and synthesis efforts on models will produce between twelve to fifteen models. The number of models referenced in the literature is much greater than this. The reduction to this number seemed likely to the planning team because of the similarity of the components of many of the models. Wherever logical, models with similar components are to be combined. Of the models which result from these synthesis activities, a few are expected to be comprehensive models, that is, they encompass all of the aspects of the phenomenon represented. The partial models which make up the remainder of the report(s) on models will represent some component of the phenomenon. The planning team estimated that seventeen man-years of research would be needed to conduct the five categories of research to be proposed in the Phase I reports and that another twenty man-years would be needed to run 40 or 50 tests of hypotheses related to and necessary in the development of those models. These activities have an estimated duration of two to five years (The figure in the chart on p. 225 is an average of the amounts estimated by the planning team). The planning team assumed that support for projects in this activity might be found from funding sources outside the U.S. Office of Education (I.g., private foundations and other federal agencies). The breakdown between U.S.O.E. and other support is also shown in the chart on page 225.

Once models have been developed to criteria stated in Chapter VIII, work can begin on Activity 2, the invention and testing of prototype instructional system components. The planning team estimated that approximately fifty projects would be funded during this activity requiring 75 professional man-years of effort over a two to six year period. Again, this activity is one for which outside support is anticipated. The items to be developed in some of these projects are instructional materials that have commerical potential. The planning team anticipates the involvement of education industries in this work.

Activity 3 in Phase II involves the operation of Adaptive Experimental Laboratories. These are to be on-going reading instruction programs augmented by expertise in reading and research and evaluation. The major expense in these agencies is the operation of a reading program. That expense is currently being borne by a school system and should continue for the duration of its operation of an Adaptive Ecperimental Laboratory. The funds of the TRDPR are to be used for augementing the personnel of the on-going program making possible the addition of reading, research, and evaluation expertise. The anticipated output of these projects is again instructional materials and procedures effective in achieving a specified reading objective. As in the previous case, the planning team anticipates an involvement of agencies other than the U.S. Office of Education in this work. In setting the duration of this work at from two to eight years and an expenditure of 34 man-years of effort, the planning team has indicated that the personnel employed by these funds would work on the Adaptive Experimental Laboratory effort on a part-time basis.

Activity 4 and Phase II involves the development of observational procedures for use in monitoring reading instructional practices. This work is necessary if the process of instruction is to be effectively monitored as required in the operation of Adaptive Experimental Laboratories. The need for the products of this effort are such that a year and a half duration has been set. Again, outside support is anticipated for about half of the six man-years of professional time the planning team thought necessary.

In Phase I, Activity 3 started the procedures for developing a criterion instrument for the Targeted R&D Program on Reading. That effort sets the stage by determining the reading behaviors to be measured and the population on which the measures will be used. The development of the program criterion instrument is continued in Activity 5 of Phase II. The work here involves the creation and validation of an instrument which meets the specifications set in Phase I. The program plan also calls for the administration of that validated instrument on a representative sample of the target population as a gauge of the extent of the reading problem. Seven man-years of effort compressed one and

a half years was the level of effort estimated. Again, the commercial nature of the product makes it likely that financial support outside U.S.O.E. could be found.

Activity 6 focuses on the outputs of Activities 2 and 3 in Phase II. Both of those will generate products that are potential components for a functional-reading-competence instructional system which have proven effective in the hands of the developers. Activity 6 answers the question of the component's effectiveness in the hands of others. The planning team estimated that these confirmation tests might require thirty projects involving 80 professional man-years over a two to eight year duration. These tests are to take place in settings in which the program's target population is found. Because these confirmation efforts take place in local settings and are, in effect, tests of local operations, a large portion 75 per cent of the costs for these activities is expected to come from sources outside the U.S. Office of Education.

Two additional items are presented under Phase II in the chart on page 225: the operation of the program's information system; and the peroidic administration of the program criterion instrument through the life of the TRDPR. The information system is anticipated to have a life that is one year shorter than the total program as it is initiated at the completion of Phase I. This means an estimated duration of nineteen years. The planning team estimated the professional man-year needs for the information system to be 57, three men per year for nineteen years. (Note all the information system operation is shown on the one line in Phase II. This one listing covers its operation during Phase II and the remaining phases of the program.)

The measurement and analysis personnel were detailed by the planning team due to the periodic need to assess the extent of a reading problem. It was anticipated that five more administrations of the criterion instrument on a national sample would be necessary if the Targeted R&D Program has a total duration of twenty years. Each administration was estimated to require two professional man-years of effort.

Phase III activities are predicated on the existence of an array of instructional system components. The work in Phase III is the design and testing of several instructional systems. The planning team estimated 200 man-years over a two to eight year period. During that period one or two of perhaps six to ten partials will emerge as effective in achieving the program goal. The planners anticipated that the majority of this effort would require financial support from Office of Education funds due to the costs of system design and testing. Some support from other sources is recognized because of the commercial nature of the products of this phase. The testing effort in this phase should involve 30 to 50 school systems selected in a manner which assures

representativeness to the total population. The 200 man-years of effort would concentrate most heavily on the design activities of the phase.

Phase IV starts with a proven effective instructional system. The nature of that system and of the environments in which it is to be operated must be examined carefully. The work of Phase IV will develop the supportive auxiliary items that are needed to effect the needed level of compatability between the proven instructional system and the environments in which it is to be operated. The items developed through this work are to be widely tested. The planning team anticipated the involvement of 200 to 300 school systems in these tests. Since these tests amount to the installation and operation of a reading program it was expected by the planning team that a large portion of this effort would be from other than OE funds. The 100 man-years of OE support that is shown was listed primarily for the design aspects of this phase.

The final phase of the Targeted R&D Program on Reading focuses on implementation strategies. It was estimated that three man-years of effort telescoped into a year ought to generate the data and information necessary for those individuals who will participate in the decisions on implementation necessary to achieve the program goal.

Throughout this appendix a unit of "professional man-year" has been used. Analysis of the research efforts undertaken with federal funds indicates that a "professional man-year" has a cost of approximately $50,000. Thus, the units used in the discussions above speak directly to the number of professionals and indirectly to the research assistants and clerical personnel needed.

It should be recognized that the figures generated above are estimates. As work progresses and more program detail is generated it will be possible to solidify these estimates. It should also be remembered that findings in Convergence Technique applications can alter the logic of the entire program. When this occurs in the Targeted R&D Program on Reading, these cost estimates must be modified also.

APPENDIX H

SUGGESTED ACTIVITIES FOR PHASES III, IV, AND V OF THE TARGETED R&D PROGRAM ON READING

During the discussions of the planning team through which the structure of the multiphased Targeted Research and Development Program on Reading was evolved, a number of quite specific research and development projects were identified. The report to which this statement is appended details those projects identified as part of Phase I and discusses general categories of activities for the reamining phases. This presentation is consistent with the Convergence Technique, the procedure used in developing the Targeted Research and Development Program on Reading. Activities posed as Phase I will do three things:

1. Develop a rationale which selects and delineates the reading behaviors which will make up the program goal;
2. Identify and analyze existing models of the phenomena inherent in reading (e.g., the reading process, the learning to read process, and language development related to reading) and specify the research needed to further develop those models; and
3. Determine (through the use of available literature and data) the nature of instruction through which reading behaviors are developed and the products of that instruction.

When these three efforts are complete specific research and development projects for Phase II can be specified.

To try to specify Phase II activities before Phase I is complete would create two problems. First, it is both presumptious and dangerous to predict the output of Phase I. A thorough search and synthesis of existing models of the listed phenomena, of the practice and product of reading instruction, and of the behaviors toward which the program is oriented has not been undertaken to date. The body of literature to be searched is so large and diffuse that the selection of a model and specific research studies on it prior to the completion of a systematic synthesis cannot be made with confidence that it has not already been done. Second, the specification of hypotheses to be tested calls to attention a particular model. To do this in the body of this report risks biasing the literature search and synthesis in the direction of that model.

The planning team, wishing to avoid these two problems and to emphasize that no existing model has preference over the

others, asks that the examples of work in the several phases of the Targeted Research and Development Program on Reading be interpreted as examples; just that and nothing more. To aid in this interpretation the project director made the decision to exclude them from the body of the report. Since examples can be helpful if seen in perspective, and since they are an historical component of the planning team's discussions they are presented in this appendix. Their listing here should in no way be interpreted as THE research that is to be done in the Targeted R&D Program on Reading. The necessary research for TRDPR will be specified as each phase of it progresses. The plans call for work in each phase which details the work of the next. The products of that work along with suggestions generated outside the programatic effort will be merged by planning groups as the program advances.

As will be noted below, no examples are given for Phase I activities. Those are detailed in the body of this report.

EXAMPLES OF PHASE II ACTIVITIES

Activities related to the general development of models.

1. A study which develops a definitive statement on the process and role of theory and model building and which presents a flow chart of model building activities as they relate to educational purposes.
2. Analyses of terms from different models which have surface level simularity so that the nature and degree of their similarity and differences are empirically documented. Gage and Unruh cite three terms which provide a specific example, "entry behaviors," "readiness," and "pre-existing cognitive structure."[1]
3. "Crucial experiments" to establish that models are identical or different need to be conducted. Henry C. Ellis sets the context for these studies as he asserts

> In order to test a theory in science, as I understand theory testing, you do not begin by arguing about the descriptive properties per se of the theoretical concept; that is, one does not argue about the content of the intervening variable or mechanism that presumably explain the data. Rather, one determines if there are

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[1]N. L. Gage and W. R. Unruh, "Theoretical Formulations for Research on Teaching," Review of Educational Research. 37:358-370; June 1967. p. 366.

systematic differences in the predicted outcomes of the alternative explanations, and attempts to test these alternative predictions in some common test situation. If, in fact, two theories predict the same thing, then they can be regarded as the same theory; until we can distinguish between predictions, they remain functionally identified.[2]

Activities related to the development of models of the reading process.

1. Studies which would observe proficient adult readers to determine what is occuring, what elements exist in their behaviors. These studies should be followed by longitudinal and cross-sectional studies to document the existence of identified elements.
2. Studies which would test elements of the Goodman Model of reading such as:
   a. To what extent are leters or symbols off the direct point of eye fixation (and thus out of focus) seen and used as cues in reading.
   b. What is the information form of the "perceptual image formed" element of the Goodman model?
   c. What are the cues at the word (or phrase) level that are used by good readers?
   d. What is the variability within which these cues can be properly interpreted by the good reader?
   e. Are there different strategies in the "selection of cues" as posed by Goodman? If so, what are they?
   f. Is "prediction" of content as proposed by Goodman, a component of the reading process? If so, what is its function in the process? How does it work?
3. Studies of visual facility in children to determine
   a. If mini-movements correlate with rate of reading?
   b. Can mini-movement rates and patterns be modified?
   c. How mini-movements affect seeing of features and cues in material to be read?
4. Studies which the nature and role of "inner speech" in reading? What is the nature of this phenomenon in deaf readers?
5. Projects designed to evolve a model of the reading process in computer simulation form.

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[2]Henry C. Ellis, Discussion in Learning Research and School Subjects. Robert M. Gagne and William J. Gephart (Eds.) Itasca, Illinois: F. E. Peacock, Publishers, 1968. pp. 99-100.

Activities related to the development of models of the learning to read process.

1. Studies designed to correlate factors in early childhood environment with ability to learn to read.
2. Studies which would examine the question of the sequential nature of the process underlying the acquisition of reading behavior and of reading skills. Is there an identifiable sequence? If so, what are its stages?
3. Studies which determine the relationship between chronological age and stages of learning the reading process.
4. Studies which develop procedures for observing transitions between learning to read stages.
5. Studies which investigate the extent to which comprehension (assuming ability to recognize words and phrases) is influenced by vocabulary and/or linguistic understanding.
6. Studies which determine the consistency of eye movement patterns (particulary mini-movements) in different stages of learning to read.
7. Studies which determine whether horizontar or angular eye movements are more directly under the control of the individual.

Activities related to the development of models of the process of language development related to reading.

1. Studies to determine the order of language acquisition and the stages in that order.
2. Studies which determine the critical period for the mastery of each of the stages in 1 above.
3. Studies which detail the strategies followed by the learner in forming and testing hypotheses about language.
4. Studies which determine the level of language development necessary before reading instruction can profitably be undertaken.
5. Studies which determine the nature of language development which coincides with learning to read.
6. Studies of bilinguals in the process of learning to read (that is, children who have learned one set of rules for oral-aural language but must learn to read using a second set of rules).

Activities related to Adaptive Experimental Laboratories

1. Studies which would develop a sequence or definition chart of the components or elements inherent in the reading instruction process (i.e., the student,

the teacher, the social and physical environment, the media, the materials, and the methodology or approach used in instruction).

2. Studies which would describe the above components and the variation in them.
3. Studies which would delineate the nature of the interactions among the components of reading instruction.
4. Studies which would develop methods of observing and classifying classroom behavior of the learner and the teacher.
5. Studies which would classify existing lab-clinic organizations by reading problems dealt with, methods used for diagnosis and treatment, and skills needed by the clinicians.
6. Studies which would delineate the deficiency and difference assumptions that seem to underly the work on teaching reading to speakers of non-standard dialects and for whom the first language is not English.

INFORMATION SYSTEM ACTIVITIES

1. Activities which would develop an instrument to be used in continued assessment of the methodological adequacy of research done both in and outside the TRDPR.
2. Continued search for materials, approaches, and research reports which relate to the models being investigated in Phase II of the TRDPR.
3. Develop and continually update a glossary of terms related to the program and the phenomena investigated in it.
4. Monitor other information collecting, processing, and dissemination organizations for information related to the program and the process of meeting the program's informational needs.
5. Studies which would examine the relationships between existing instructional systems and models being investigated within the program.
6. Studies which would interpret research findings produced by studies both within and outside the TRDPR in terms of the models and/or instructional approaches being investigated in the program.

ACTIVITIES FOR PHASES III THROUGH V

Phase III Activities

1. Prepare a catalogue of media (both available and possible) for presenting material to children.

2. Evaluate identified media in terms of utility, reliability, cost, flexibility.
3. Catalogue and evaluate materials available for use in the instruction process.
4. Design and test alternative instructional systems using components developed in Phase II.

Phase IV Activities

1. Delineate the skills and knowledge needed by individuals who will operate an instructional system that has been proven effective.
2. Identify the degree to which these skills and knowledge are possessed by the individuals in the institutions where the instructional system will be operated.
3. Design and test procedures and materials needed to develop the skills and knowledge necessary to operate the system.
4. Design and test materials to be used by local agencies to influence parents to provide the environmental conditions (physical, behavioral, and attitudinal) necessary to facilitate the functioning of the reading instruction system.

Phase V activities.

1. Survey currently used and possible methods of changing the way schools teach reading.
2. Identify individuals who will make the decision to implement or not to implement the proven system.
3. Design and test several "current awareness packages" to determine most effective implementation strategies.

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